EVALUATION OF THE FUNCTIONAL OUTCOME OF TOTAL KNEE ARTHROPLASTY PCL RETAINING VERSUS SACRIFICING

Dissertation Submitted in

Partial fulfillment of the University regulations for

MS DEGREE IN

ORTHOPAEDIC SURGERY

BRANCH II

TIRUNELVELI MEDICAL COLLEGE

THE TAMILNADU DR. M.G.R. MEDICAL UNIVERSITY

CHENNAI, INDIA

APRIL 2014

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He has completed the necessary period of stay in the department and has fulfilled the condition required for submission of this thesis according to university regulations. The study was undertaken by the candidate himself and the observations recorded have been periodically checked by us.

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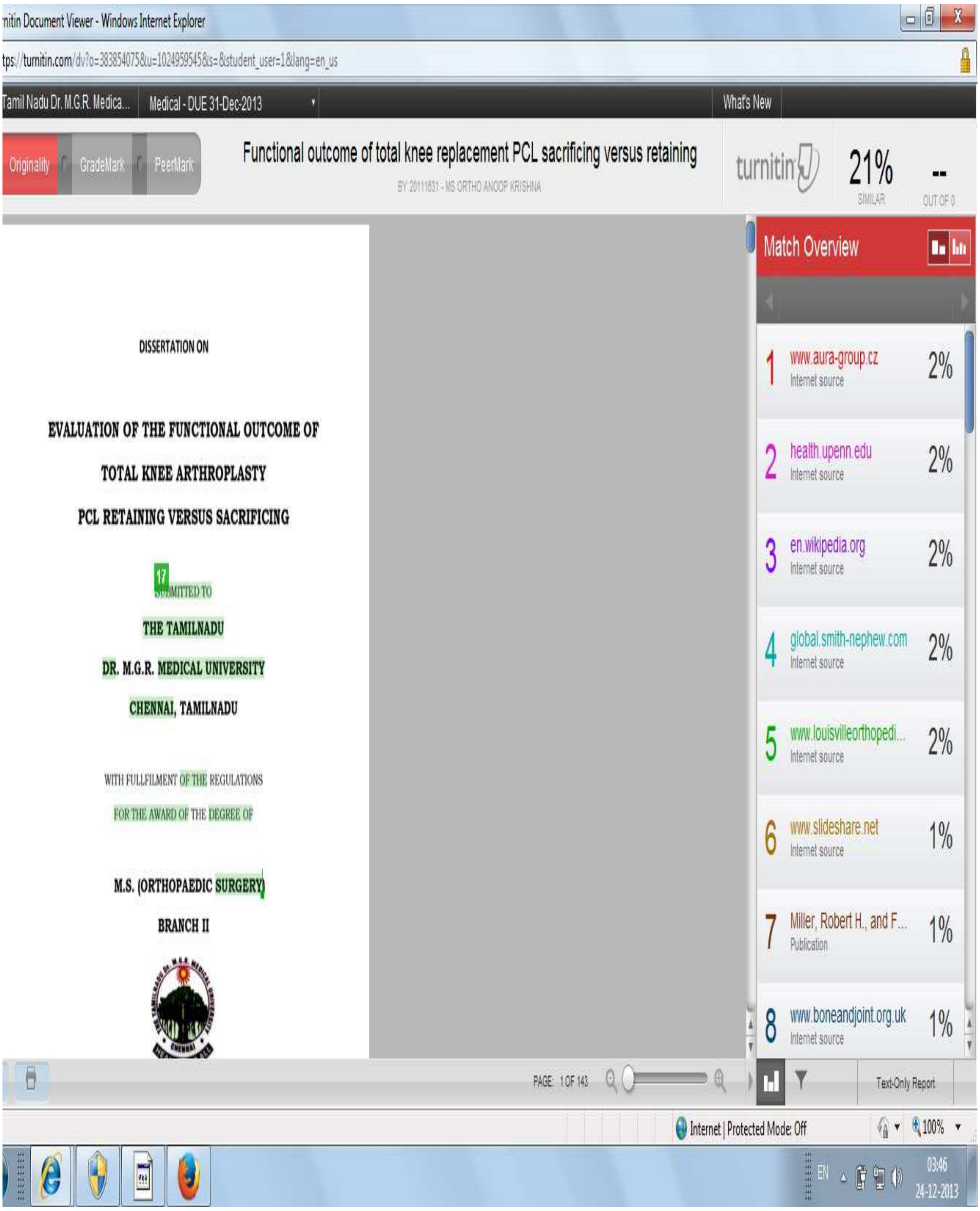
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DECLARATION

I, **Dr. ANOOP KRISHNA.,** solemnly declare that this dissertation titled **"EVALUATION OF THE FUNCTIONAL OUTCOME OF TOTAL KNEE ARTHROPLASTY PCL RETAINING VERSUS SACRIFICING"** is a bonafide work done by me at Tirunelveli Medical College during 2011-2014 under the guidance and supervision of **Prof.ELANGOVAN CHELLAPPA. M.S.ORTHO, D.ORTHO** Professor and Head of the Department, Department of Orthopaedics, Tirunelveli Medical College, Tirunelveli.

I have not submitted this dissertation to any other university for the award of any degree or diploma previously. This dissertation is submitted to The Tamil Nadu Dr. M.G.R. Medical University, Chennai towards partial fulfillment of the rules and regulations for the award of **M.S Degree in ORTHOPAEDIC SURGERY (BRANCH – II)**

PLACE :

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(Dr. ANOOP KRISHNA)

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CONTENTS

ABSTRACT

TITLE: EVALUATION OF THE FUNCTIONAL OUTCOME OFTOTALKNEE ARTHROPLASTYPCL RETAINING VERSUS SACRIFICING.

INTRODUCTION

The role of Posterior cruciate ligament in total knee replacement is controversial. Theoretically it has been suggested that PCL retaining can produce femoral rollback, which increases the range of flexion and prevents posterior translation. This in effect, reduces loosening and excessive polyethylene wear by decreasing the shear stresses at the fixation surfaces.

We conducted a prospective study to compare resection with retention of PCL using a standard PCL–retaining cemented total knee replacement and assesed the functional outcome using functional knee scores and WOMAC score during the period between January 2012 to June 2013.

AIM

The aim of the study is to prospectively compare the functional outcome of Primary Total Knee Replacement done in our hospital during the period of January 2012 to June 2013 between patients in whom Posterior cruciate

ligament(PCL) was retained with those were it was sacrificed using Knee Society Knee Scoring and Functional Knee Score and WOMAC Questionnaire.

MATERIALS AND METHODS

The study was done on 20 patients. Scoring system formulated by the WOMAC Score, Knee Society Knee Score and Functional Knee Score were used to evaluate the patients before and after surgery. Both knee scores and functional scores are calculated with each amounting to a total of 100 points and WOMAC Score with max of 96 points. Preoperative full length radiograph from the hip to ankle was taken in all the patients who underwent knee replacement surgery and pre op mechanical axis was drawn and the amout of varus or valgus deformity was quantified. Radiological grading as advocated by Kellegren and Lawrence was used to evaluate the severity of the arthritis. PCL was retained in five patients who had minimal deformities with no flexion contracture pre operatively and PCL was sacrificed in rest of the patients.

RESULTS

Analyzing the functional outcome it was found that all the patients in both the groups had significant improvement in their knee score and the functional knee score.Analysing the total Knee Scores, the average Knee Society Score for the PS group was 85.80 and that of CR group was 75.60 and statistical analysis revealed a significant difference in the the p-value in favour of Cruciate Sacrificing Prosthesis signifying that **Cruciate Sacrificing Prosthesis has better functional outcome.** The functional knee society also showed a marked improvement in all patients,for CS group FKS was 99.6 and for CR group it was 91.6.Statistically there was no significant difference.The WOMAC Score also showed a marked improvement.In CS groups it was 24.6 and in CR it was 27.4.Statistitical analysis showed a highly significant **difference in favaour of cruciate sacrificing prosthesis**.

CONCLUSIONS

- **Total Knee Arthroplasty in patients in whom posterior cruciate ligament was sacrificed was found to have a better functional outcome as compared to the retaining group,which can be mainly attributed to the persistence of flexion deformity in cruciate retaining group.**
- **In Indian scenario where knee replacement is done at a late stage of osteoarthritis ,sacrificing the contracted posterior cruciate ligament has better outcomes as compared to retaining it.**

KEY WORDS

Total knee arthroplasty,posterior cruciate ligament,Knee society knee score,Functional knee score,Womac score.

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ANATOMY OF KNEE JOINT

The knee is a complex pivotal hinge joint that connects the bones in the upper and lower leg. It is the largest synovial joint in the body[2]. The knee consists of two articulations: one between the femur and tibia, and one between the femur and patella. The knee is a mobile trocho-ginglymus (a pivotal hinge joint), which permits flexion and extension as well as a slight internal and external rotation.

Although the design of knee joint has not changed fundamentally over millennia, it is vulnerable to both acute injury and the development of osteoarthritis. Of the weight bearing joints it is the most subjected to wear and tear. The ligaments of the knee which along with the muscles and tendons form the major structures for stability of the knee.

The structures around the knee has been classified into three groups by Larson[3] namely the

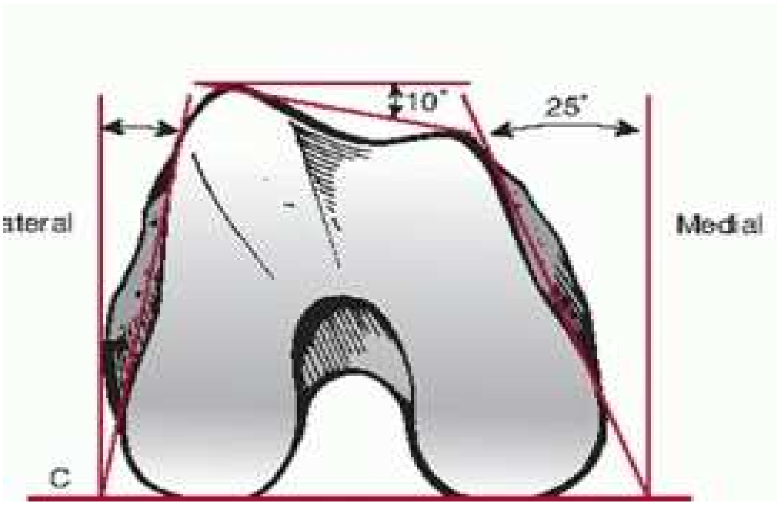
- Osseous structures
- Extra-Articular structures and
- Intra-Articular structures

Osseous structures:

The osseous structures of the knee consists of three components.

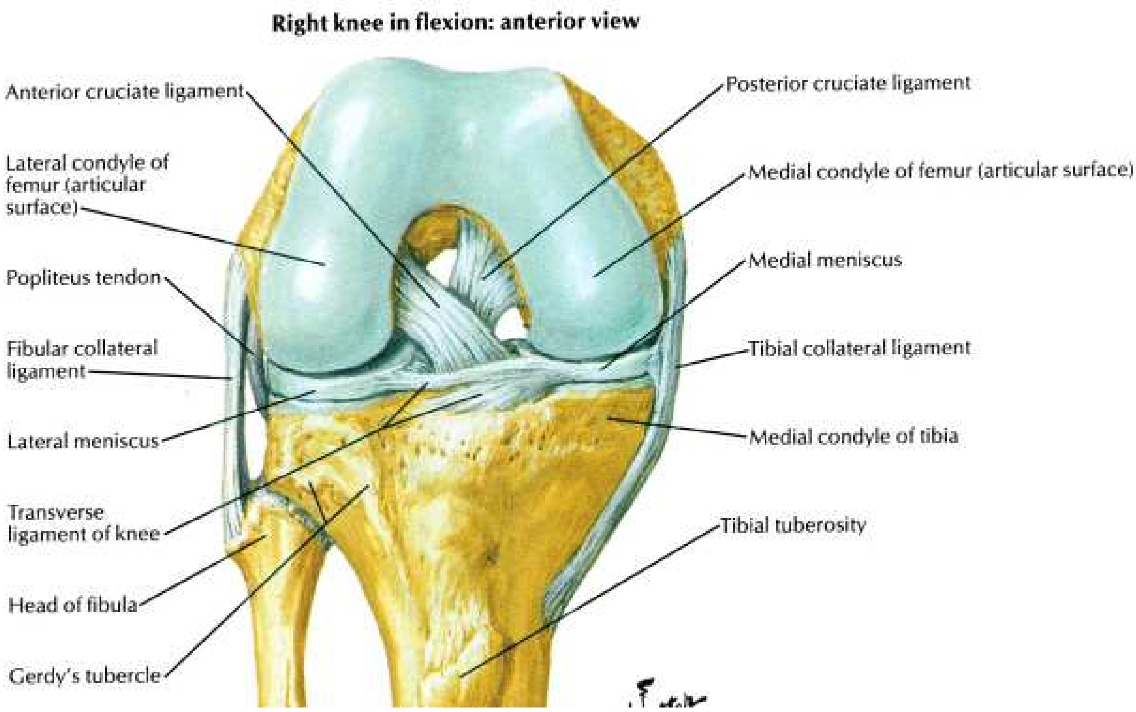
1. **Femoral Condyles:** The Femoral Condyles are two rounded prominences that are eccentrically curved, they being curved more anteriorly than posteriorly. The articular bodies of the femur are its lateral and medial condyles. These diverge slightly distally and posteriorly, with the **lateral condyle being wider in front than at the back while the medial condyle is of more constant width[3].** The radius of the condyles curvature in the sagittal plane becomes smaller towards the back. Anteriorly they are flattened and provides a greater surface area for contact and weight transmission[3].

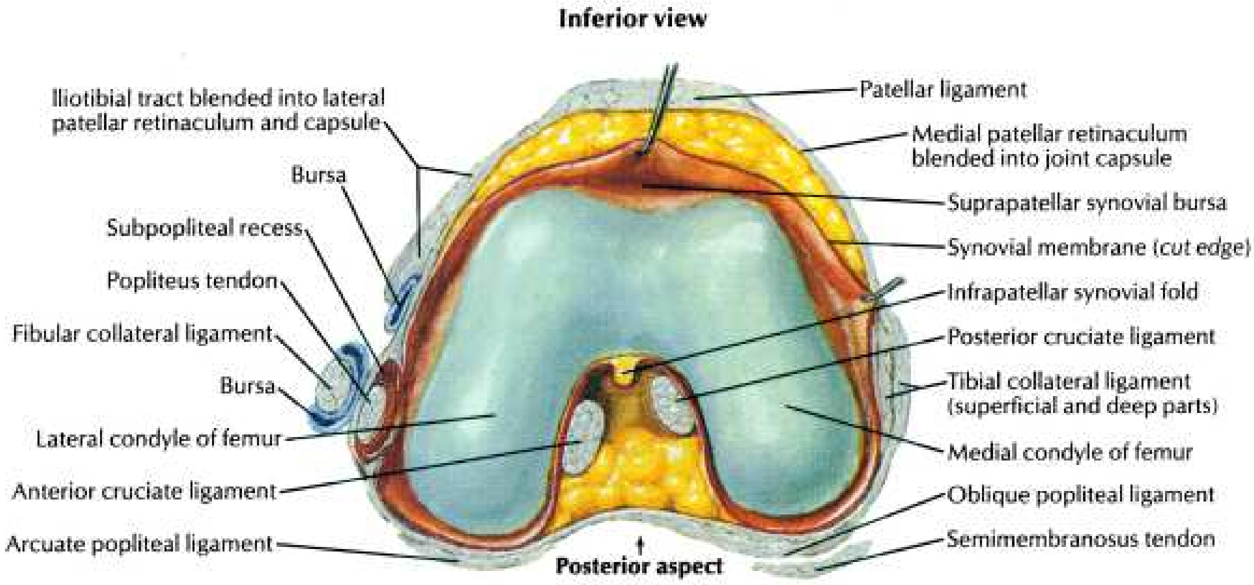
   The patello-femoral groove on the anterior aspect accepts the patella. Posteriorly the intercondylar notch separates the two condyles. If viewed on end, the shape of the distal femur is trapezoidal (narrower anteriorly than posteriorly) with an angle of inclination on the medial surface of about 25 degrees[6]. Anteriorly, the articular surfaces of the two condyles come together to form a joint for articulation with the patella. Posteriorly, they are separated by a deep intercondylar fossa that gives attachment to the cruciate ligaments of the knee. The contact surface for the patella includes parts of both condyles, but is derived predominantly from the lateral condyle. The lateral condyle is broader and extends farther proximally. The lateral epicondyle arises from the lateral condylar surface, giving rise to the fibular collateral ligament. Immediately below the lateral epicondyle is an oblique groove that houses the popliteus tendon. The medial epicondyle is longer than the lateral condyle and extends farther distally. Its medial surface is convex and contains an epicondyle that gives attachment to the tibial collateral ligament. Situated on the proximal-most part of the condyle is the adductor tubercle, into which the tendon of the adductor magnus muscle inserts(1).



Normally the knee joint is oriented parallel to the ankle and ground. The anatomic axis of the femoral shaft relative to the knee averages about 8 degrees of valgus, with some variability between individuals (range, 5 to

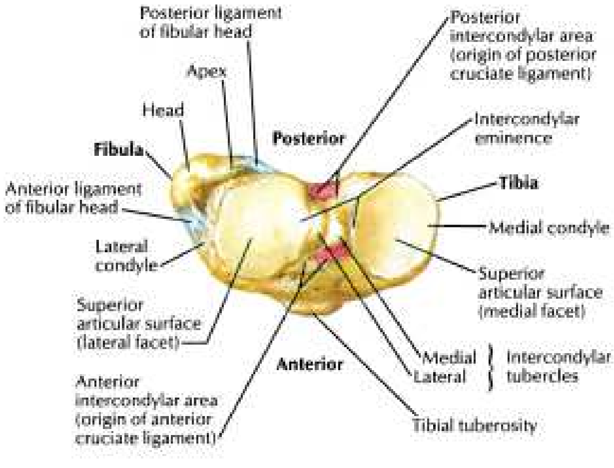
12 degrees)[1]. The expanded femoral and corresponding tibial condyles are adapted for the direct forward transmission of weight. During weight bearing, the two condyles rest on the horizontal plane of the tibial condyles and the shaft of the femur inclines inferomedially. This inclination is an expression of the greater width of the body at the hips than the knees.

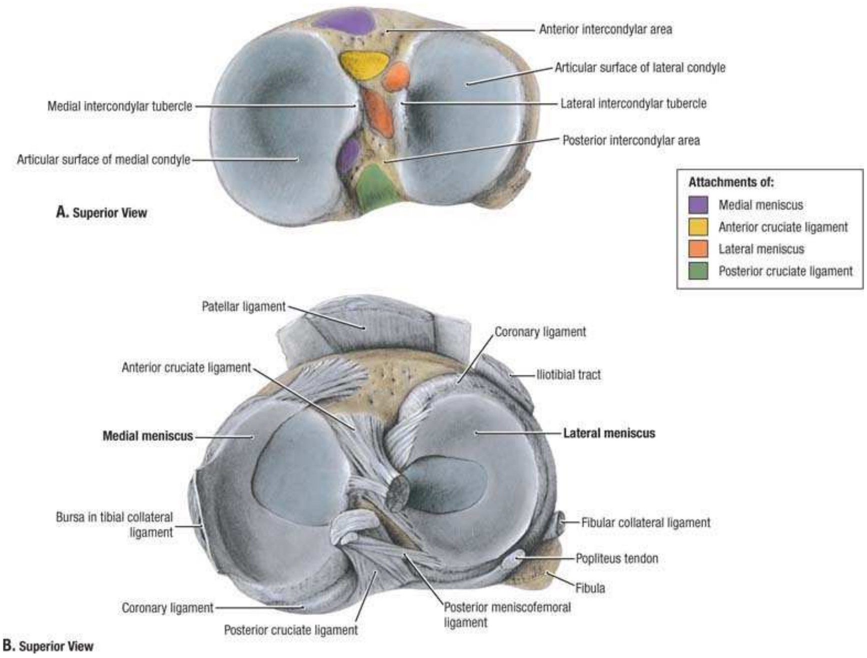




2. Tibial Plateau: The tibial plateau is formed by the expanded proximal end of the tibia. They articulate with the femoral condyles. They have a median intercondylar eminence.

The Lateral Tibial Condyle is flatter, shorter from anterior to posterior, and more circular. The Medial Condyle is concave, longer from anterior to posterior, and more oval.



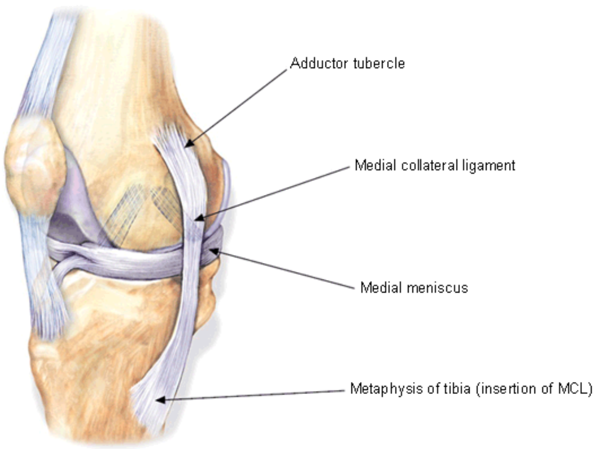


3.Patella: The patella is a triangle shaped sesamoid bone that is wider proximally than distally. The articular surface of the patella has a vertical ridge which divides it into a smaller medial and a larger lateral articular facet or surface[6].

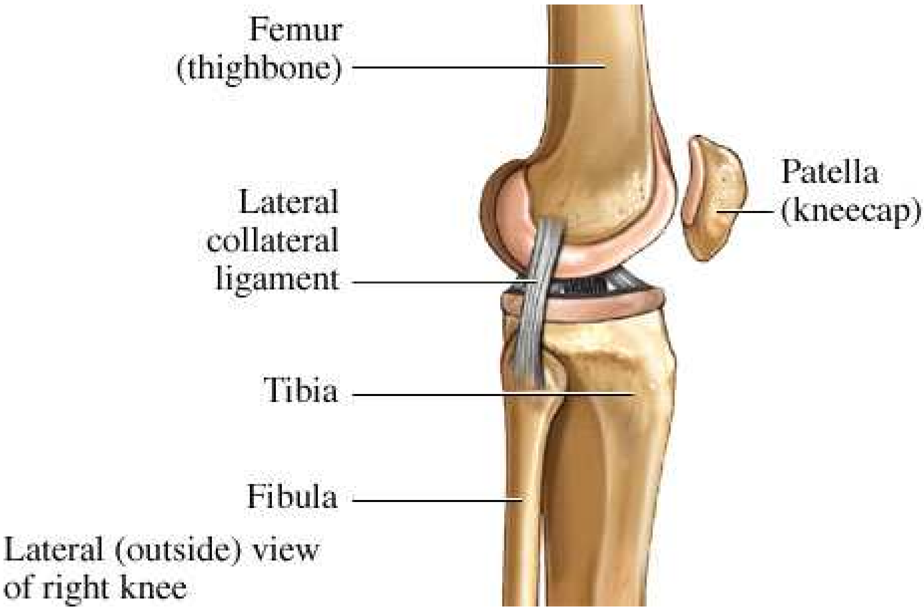
Extra-Articular Structures:

The Extra-Articular structures supporting and influencing the functioning of the knee joint are the Collateral Ligaments and the Musculo-Tendinous Units.

The Tibial Collateral Ligament lies superficial to the medial capsule, it is attached to the medial condyle of femur and to the postero-medial tibial metaphysis about 7-10 cms below the joint line. It is the major stabilizer against valgus stress.



The Fibular Collateral Ligament attached to the lateral epicondyle of femur proximally and to the fibular head distally. It provides the principal stability against varus stress.

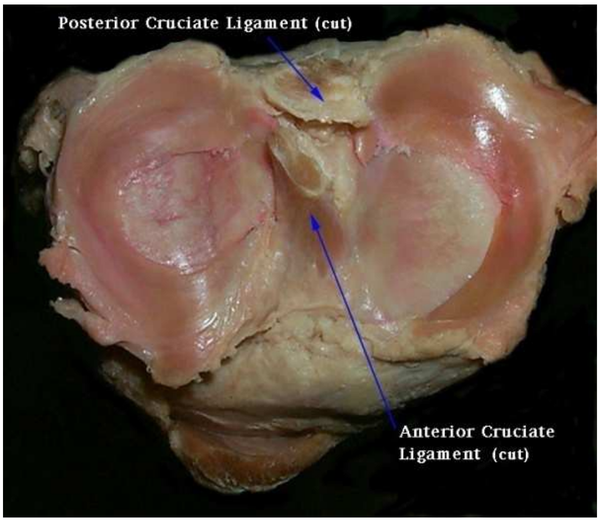


The Musculo-tendinous Units supporting and stabilizing the knee joint are the Quadriceps mechanism, the Gastrocnemius, the Pes Anserinus, the Hamstrings, the Iliotibial tract and the Popliteus.

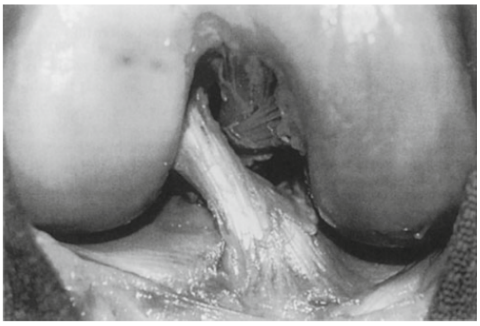
Intraarticular structures:

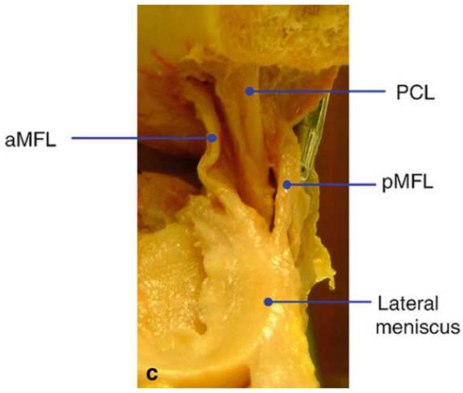
The Principal Intraarticular structures are the Menisci,Medial and Lateral Menisci, Anterior Cruciate Ligament and Posterior Cruciate Ligament.

The **Menisci** acts as spacers and therefore deepens the joint, reduces the stress on the articular cartilage and prevent mechanical damage to the Chondrocytes. The Menisci are cresentric with triangular cross section covering 1/2 to 2/3 rd of the articular surface of the corresponding tibial plateau by coronary ligaments.



The **Anterior Cruciate Ligament** is a thick band of fibres attached on the tibia anterolateral to the anterior tibial spine, the fibres wind on themselves and run obliquely to get attached to a crescentric area on the medial aspect of the lateral femoral condyle.

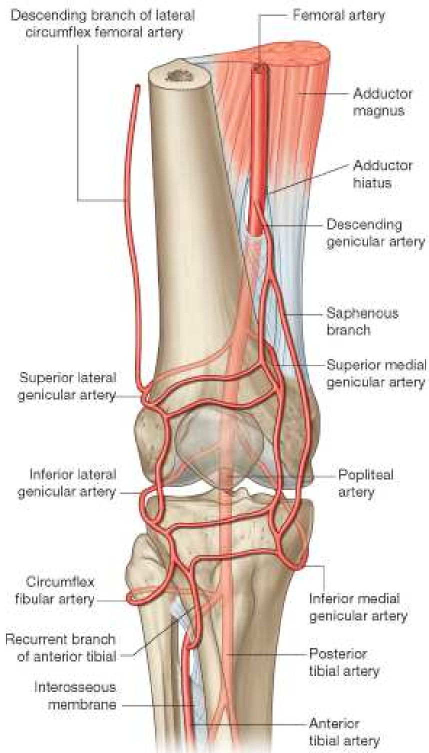




The **Posterior Cruciate Ligament** is more vertical and short. PCL is twice as strong and is double the thickness of the normal ACL. It has two bundles the a**nterolateral bundle which comprises about 65% of the PCL** and the p**osteromedial bundle** comprises 35% of the PCL.

Anastomosis[1]:

The knee joint is very vascular and is supplied by a vascular plexus formed by Five Genicular Arteries namely the Superior Lateral, Superior Medial, Inferior Medial, Inferior Lateral, and the middle Genicular Artery and by Descending Genicular Artery, a branch of the Femoral Artery, Descending branch of the Lateral Circumflex Femoral Artery and Anterior Tibial Recurrent Artery, a branch of the Anterior Tibial Artery.



Nerve supply(1) :

The major nerves supplying the knee joint are

1) Tibial Nerve.
2) Lateral Popliteal Nerve.
3) Infrapatellar br of Saphenous Nerve

BIOMECHANICS

The shaft of the Femur is placed in a slight oblique direction (9^0 valgus to the mechanical axis)in such a way that the femoral condyles are towards the vertical axis of the body and hence the lateral condyle of the femur is more in line with the femoral head. To maintain the distal end of femur in a horizontal plane the medial condyle extends far distally than the lateral condyle.

In the frontal plane both the femoral condyles have slight convexity of both the condyles and the lateral condyle is shifted forwards in reference to the medial femoral condyle and in Sagittal Plane, the medial and lateral condyles are convex, having a smaller radius of curvature posteriorly.

The articular surface of the lateral femoral condyle is smaller than the articular surface of the medial femoral condyle. When the femur is examined through an inferior view, it can be seen that the lateral tibial surface ends before the medial condyle.

In a normally aligned knee the Mechanical axis of the lower extremity passes through the centre of the knee joint. In bilateral stance, the weight bearing stress is distributed equally to both the medial and lateral condyles but in a unilateral stance (i.e. during stance phase of gait) on account of the smaller base the weight bearing axis is shifted medially which predisposes the medial compartment for degenerative arthritis earlier than the lateral compartment.

The Knee Joint is a double Condyloid Joint with freedom of Angular Motion in three planes namely sagittal, transverse and frontal planes(3) .

1. **Sagittal Plane:** The primary movement occurring in the knee joint is Flexion/Extension, the axis for this movement can be simplified as a horizontal line passing through the femoral medial and lateral epicondyles. Though the transepicondylar axis represents the axis for flexion and extension, this axis is not truly fixed but keeps shifting during range of motion which is because of the incongruent large articular surface of femur and small tibial condyle creating a problem when the femur flexes on the fixed tibia.

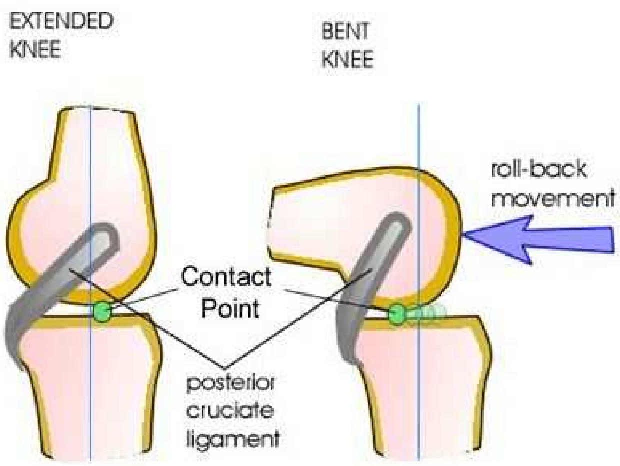
    The first 25° of Knee Flexion occurs primarily as rolling of the Femoral Condyles on the Tibia bringing the Femoral Condyles posteriorly on the Tibial Condyle. When flexion is continued, the rolling of the femoral condyle is accompanied by a simultaneous anterior glide that creates a nearly pure spin of the Femur on the posterior Tibia with little linear displacement of the Femoral

Condyles after 25° of flexion. Extension of the Knee from Flexion is essentially a reversal of this motion[5,6,16,17] .

FEMORAL ROLL BACK[5,6,8,9]

Normal Knee

As the normal knee flexes, femoral rollback occurs. The lateral femoral condyle, having a larger radius of curvature, rolls back farther posterior than the medial femoral condyle. This rollback is guided by the posterior cruciate ligament (PCL). The asymmetric rollback results in the tibia internally rotating relative to the femur during flexion.



In the TKR patient, normal kinematics must also be guided by a functioning PCL.

If the TKR is posteriorly unstable, paradoxical anterior slide of the femur on the tibia occurs and normal knee kinematics are not exhibited. This paradoxical anterior slide of the femur on the tibia during flexion can be a cause of instability.

1. Difficulty with stairs and inclines (particularly going down),
2. Pain when the knee is flexed and loaded, such as with recreational athletic activities,
3. Paradoxical anterior femoral slide on the tibia can be a cause of intermittent effusions as the femur repetitively stresses and irritates the anterior capsule of the knee.
4. In addition, anterior sliding of the femur can cause earlier impingement of the posterior polyethylene on the back of thefemur, thus preventing high flexion from occurring.

To achieve a high-flexion, symptom-free knee, normal kinematics must be understood. It is not satisfactory to achieve deep flexion knee arthroplasty if it is posteriorly unstable and functionally symptomatic due to altered knee kinematics.

PCL RETAINING

Native PCL promotes posterior displacement of femoral condyles similar to a normal knee.

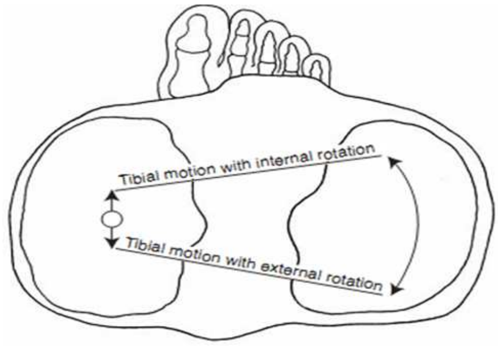
PCL SUBSTITUTING

Here the tibial insert has got a post which comes in contact with the femoral cam causing the posterior displacement of femoral condyles.

PCL SACRIFICING

Deep dished insert helps in femoral rollback and prevents the anterior translation.

Internal and External rotation of the knee joint



Roatory Movements of the Knee Joint

Transverse Plane:

Rotational movements of the knee is described as angular relative motions of the tibia on the femur, Internal and External rotation takes place around a longitudinal axis that runs close to or through the medial tibial intercondylar tubercle and, the medial condyle acts as the pivot point while the lateral condyles moves through a bigger arc of motion, regardless of the direction of rotation. During rotational movements, the menisci will distort in the direction of movement of its respective femoral condyle to maintain its relationship with the femoral condyles as they do in flexion and extension. In this way, the menisci continue to reduce the friction and distributes forces without restricting motion of the femur. Axial rotation is permitted by incongruity of the articular surface and laxity of ligaments. Hence rotational movement of knee depends on the degree of flexion of the knee at that particular point. At full extension the ligaments are taut tibial tubercles are lodged in the notch and menisci are firmly interposed between the articular surfaces, which makes any rotation hardly possible.

Frontal Plane:

Abduction and Adduction takes place around an Antero-Posterior axis, it is the lowest among the three and the maximum range of 130^0 is possible at 20° of knee flexion and 8° only at full extension any excess movement indicates ligamentous laxity. The true flexion/extension axis of the knee joint is not exactly perpendicular to the axis of femur and tibia but is inclined obliquely because of the mismatch of the medial and lateral femoral condyles. Hence the foot which is placed laterally from the midline in knee extended position comes towards midline when knee is flexed. This combination of movements occurring in sagittal and frontal plane is termed "**coupled motion.**"(19) Therefore flexion gets coupled with varus motion whereas extension gets coupled with valgus motion .

RADIOLOGY IN TOTAL KNEE ARTHROPLASTY[1,2,3,9]

The primary aim of total knee replacement is to achieve good alignment of the femoral, tibial and patellar components. A good alignement of the components will reduce the mechanical stress placed over the bearing surfaces and the shear stress on the bone-cement-prosthesis interfaces. Good alignment also helps to balance the forces which are transmitted to the soft-tissue surrounding the knee, which is crucial for proper function of the joint.

MECHANICAL AXIS

Under normal circumstances, in the standing position, a vertical line drawn downwards from the symphysis pubis is known as the **vertical axis**. Pauwel et al described the concept of "**MECHANICAL AXIS**". Mechanical axis refers to the angle formed by a line drawn from the centre of the femoral head to the medial tibial spine and a line drawn from the medial tibial spine and the centre of the ankle joint. This line is also called as Maquet's line This should not be confused with the weight bearing axis which runs from the centre of femoral head to centre of ankle. With optimal alignment, the mechanical axis will form a straight line overlapping the weight bearing axis. In a normal knee mechanical axis passes through the anatomical centre of knee .Because the hips are more widely separated than the knees and ankles, mechanical axis is in 3 degrees valgus from the true vertical axis of the body. It normally passes through the knee just medial to the tibial spine in the frontal plane, described as 'neutral mechanical axis'. The distance of this line from the centre of the knee on a long-leg radiograph provides the most accurate measure of coronal alignment.

Mechanical axis of the femur is drawn by connecting the centre of the femoral head and the centre of the knee.

Mechanical axis of the tibia is drawn by connecting the centre of the knee to the centre of the ankle.

ANATOMIC AXIS

The Anatomical Axis refers to a line drawn along the length of the intramedullary canal of either the femur or the tibia.

Anatomical axis of femur: Line drawn from the proximal femur to the centre of distal femur or centre of knee joint. The anatomical axis of the femur makes an angle of 5˚ to 7˚ with the mechanical axis.

Antaomical axis of tibia: Line drawn from the centre of tibia to centre of ankle. The anatomical axis of the tibia corresponds to the mechanical axis of the lower limb.

The anatomical axis of the tibia thus subtends an angle of 3˚ with the vertical axis, while for the anatomical axis of the femur with the vertical axis the angle subtended is from 8˚ to 10˚ ($9^{0)}$

Anatomic tibiofemoral angle:

The angle formed when the line that forms the femoral shaft axis is extended through the distal femur to form an angle between the femoral shaft axis and the tibial shaft axis **.** The angle is represented by numbers that supplement the normal angle of alignment (e.g., 3°, 6°, etc.) and indicates the extent of anatomic misalignment or deformity.

Mechanical tibiofemoral angle:

The angle formed when the line that forms the mechanical axis of the femur is extended through the distal femur to form an angle between the mechanical axis of the femur and the tibial shaft axis **.**As with the anatomic tibiofemoral angle, this angle is represented by numbers that supplement the normal angle of alignment (e.g., 3°, 6°, etc.) and indicates the extent of mechanical misalignment or deformity.

PHYSIOLOGICAL VALGUS ANGLE : The angle formed between the anatomic and mechanic axes of femur is called the knee physiologic valgus angle.

MEASUREMENT OF THE OVERALL VALGUS OR VARUS DEFORMITY OF THE KNEE

If the femoral head is visible **:**

1. Locate the centre of the knee and centre of the femoral head.
2. Draw a line connecting these two points.
3. Locate (or approximate) the centre of the ankle.
4. Draw a line connecting the centre of the knee to the centre of the ankle.
5. Measure the angle between the 2 lines. A measurement of 0°/180° implies no deformity; otherwise, the observed angle is the angle of varus or valgus present (valgus if foot is lateral, varus if foot is medial).

Postoperative Radiographs[21]

Achieving the ideal component positions is important for the longevity of the TKA prosthesis. The mechanical axis can be measured accurately if an AP long film that includes the entire lower limbs is available . According to the classical alignment method proposed by Insall, the mechanical axis of lower limb that extends from the centre of the femoral head to the centre of ankle should pass near or through the centre of the knee, and the joint line should be perpendicular to the mechanical axis. The mechanical axis cannot be accurately measured using short AP radiographs of the knee. In such cases, the component positions can be assessed with reference to the anatomical axes of the femur and tibia instead. The femoral angle (the medial angle between the femoral anatomical axis and a tangent to the distal ends of the femoral condyles) should be about 95°. The tibial angle (the medial angle between the tibial anatomical axis and a line along the tibial base plate) should be about 90°. The overall femorotibial angle is the sum of the femoral and tibial angles, and should be about 185°. In other words, the replaced knee should be in about 5° valgus. It should be emphasised that this is only a surrogate measure for the mechanical axis.

In the lateral view, the sagittal alignment of the femoral and tibial components can be assessed . The femoral component may be in extension, neutral position, or flexion. If the femoral component is in too much extension, the risk of notching the anterior femoral cortex is increased. However, if the femoral component is in excessive flexion, knee extension may be blocked in TKA prosthesis designs that do not permit too much hyperextension.

Checking the posterior slope in lateral view is also important.We had a fixed posterior slope of 3^0 in our prosthesis. Excessive posterior slope may cause flexion instability while inadequate posterior slope or anterior slope may cause tightening of the collateral ligaments with knee flexion, thus limiting knee flexion.

The size of the components is also an important aspect; ideally, the components should duplicate the patient’s anatomy if possible. With regard to the femoral component, it should be flush with the margins of the femoral condyles medially and laterally in the AP radiograph. Any overhang is better tolerated on the lateral side. In the lateral view, the anterior flange should be flush with the anterior femoral cortex, and the posterior condyles of the prosthesis should be in line with the patient’s own posterior condyles. If the femoral component is too big, a gap may be seen between the anterior flange and anterior cortex of the femur. It may overfill the PF joint and create a tight flexion gap, both of which are associated with limited knee flexion. If the femoral component is too small, its anterior flange may cause notching of the anterior femoral cortex, or the posterior condyles may not fill up the flexion gap adequately, leading to flexion instability. On the tibial side, the margins of correct-sized components should be flush with the medial, lateral, anterior, and posterior cortices in both AP and lateral views. An undersized tibial component exposes the cancellous bone and, poses the risk of subsidence. An oversized tibial component may result in soft tissue irritation, and may affect ligament balance and limit motion.

According to the Knee Society TKA roentgenographic evaluation and scoring system, a number of zones are assigned to the fixation interfaces around each of the femoral and tibial components. This enables standardised reporting when evaluating radiographs following TKA. In the AP view of the tibial component , the plateau is divided into 4 zones (zones 1 to 4) from medial to lateral. For the tibial component without a central stem, the mid portion is zone 5. If there is a central stem, then the medial side of the stem is zone 5, the tip of the stem is zone 6, and the lateral side is zone 7.

In the lateral view of the femoral component , the surfaces over the anterior flange and anterior chamfer cut are zones 1 and 2, and those over the posterior chamfer cut and posterior condyle are zones 3 and 4. Zones 5 to 7 are for the central part or the distal cut. If there is a central stem, then the anterior side is zone 5, the tip is zone 6, and the posterior side is zone 7. For a posterior-stabilised TKA prosthesis without a stem, zones 5 to 7 and part of zones 2 and 3 are usually obscured by the femoral cam.

REVIEW OF LITERATURE

Whether to retain or sacrifice the Posterior Cruciate Ligament (PCL) still remains one of the most debated controversies in Primary Total Knee Arthroplasty. As orthopaedic surgeons search for designs that will mimic and restore the normal kinematics of the anatomic knee, the issue of importance of posterior cruciate ligament (PCL) retention continues to be of debate. Whether preservation of the PCL ,or conversely articular geometry that replicates its function,will become more successful remains to be seen. No current research shows significant difference in cruciate retaining (CR) or cruciate substituting(CS) total knee arthroplasty by long term results.PCL management in TKR is multifactorial and requires biomechanical balance, surgical technique and prosthetic design. Surgeons who are advocates of PCL substitution excise and substitute for the ligament using a Posterior-Stabilized Prosthetic design. Both PCL-preserving designs with a well-balanced PCL and PCL substituting designs do appear to provide better range of motion and stair-climbing ability than PCL-sacrificing designs theoretically[11].

Arguments between PCL retention and substitution are on the following factors

1. KINEMATIC ARGUMENTS:

Controlled femoral rollback is necessary for maximum flexion, which is a key feature in TKA. Retaining posterior cruciate liagament leads to anterior tibiofemoral contact when knee is extended, which will increase the heel-strike phase of gait.

Dennis et al. demonstrated the paradoxical anterior femoral slide with PCL-retaining prosthesis and noted near normal kinematics with PCL-substituting prosthesis[12,15]. However Study of in vivo kinematics by Stiehl et al. in PCL Retaining implants demonstrated a consistent posterior tibiofemoral contact point in extension and paradoxical roll forward in flexion which was quite different from fluoroscopic kinematics identified in normal knees[10].

2. **GAIT ANALYSIS:**

Andriacchi et al. in his study has shown near normal gait in patients with PCL retained prosthesis [17]. **Becker et al.** has reported no significant advantage clinically by comparing bilateral paired CR and PS knees. and no difference in stair climbing[35]. **Wilson et al**. performed Gait analysis in 16 patients with PS implants and showed no significant difference between joint replaced and normal knees with regard to isokinetic muscle strength testing and studied gait variables(36). Studies on Gait analysis did not show any significant benefits of one design over another.

3.WEAR & TEAR :

Earlier CR implants used flat articulating tibial surfaces due to the kinematic conflict that may result from the femoral rollback against the curved or posterior lipped. When these inserts were used they were exposed to high stress due to contact and edge loading and resulted in increased wear of the insert which was not observerd when posterior stabilized implants were used(56,57) .

4. **PCL STRAIN AND HISTOLOGIC DEGENERATION:**

Surgeons advocating cruciate retention argue that balancing or recessing of PCL eliminates the excess force on PCL and controls anteroposterior stability and and gives good flexion, but those supporting posterior stabilized prosthesis believe that balancing of the ligaments is very crucial and if it is too tight it can lead to excess wear and decreased flexion and if it is too loose can lead to ligamentous instability. These problems do not occur when posterior stabilized implant is used(38).

5. PROPRIOCEPTION:

Posterior cruciate ligament in addition to providing stability has been found to have a role in proprioception. Supporters of cruciate retaining prosthesis have shown the proprioceptive property of the knee when CR prosthesis is used. However **Kleinbart et al**. has demonstrated histologically age related degeneration of the nerve fibers inside the posterior cruciate ligament(39). Using a computer- assisted image analyzer, **Franchi et al**. has shown a 50% decrease in the nerve receptors inside the posterior cruciate ligament in patients with degenerative arthritis compared to controls(40). **Simmons et al.** found no difference in threshold to detection of passive motion in cruciate retaining versus cruciate-substituting knees(41).

6. LOOSENING:

Loosening rates in Substituting knees have been extremely low compared to Cruciate Retained group(42).

7. RANGE OF MOTION:

Average ROM in PS design has been more than 110 degrees. This value was comparatively less in cruciate-retaining knees. **Hirsch et al.** compared two groups in regard to ROM and found that patients in PCL-retaining group had 102 degrees of motion, while the PS design averaged

112 degrees. **Bolanos et al**. in his study found no significant difference in the range of motion, level walking and stairs between CR and PS[43,50]

8. STAIR CLIMBING/ WALKING:

Andriacchi et al. has shown that patients receiving Cruciate retention prosthesis are better at stair climbing and there was not much significant difference on level walking when compared to posterior stabilized prosthesis[17]. **Shoji et al.** showed no significant clinical difference in knee scores between posterior stabilized and cruciate retention TKA.

9. INSTABILITY/LAXITY:

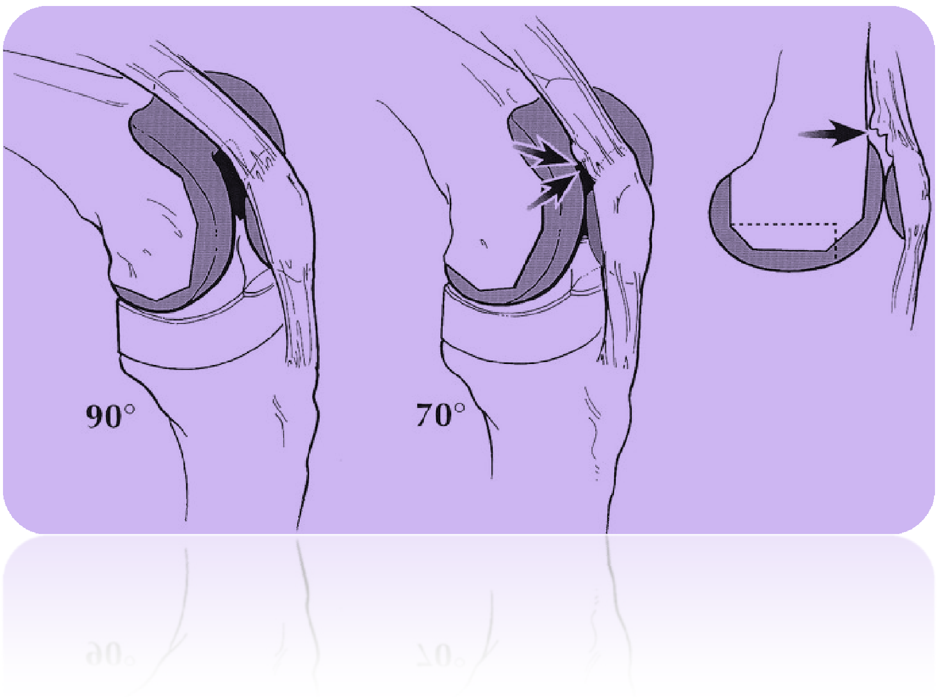
Dejour et al. has shown significant higher rate of anteroposterior and medio-lateral laxities in patients who underwent Cruciate Retaining TKA than those that underwent posterior stabilised TKA[47].

10. JOINT LINE:

PCL resection done for posterior stabilsed designs increase the flexion gap by 2-4 mm this leads to a compensatory increase in extension space for which a more proximal distal cut should be taken..This causes an elevated joint line by approx. 2–4 mm. The biomechanical implication of an elevated joint line is an important issue that should be considered. It is likely that altering the joint line less than 8 mm in either direction may be well tolerated. **Singerman et al.** in his study showed that elevating joint line 1 cm reduces strain on patella but may lead to patella baja and impingement of the insert and decreased motion. When cruciate is retained joint line should not be elevated as this may cause stress on the PCL[44].

11. PATELLAR CLUNK SYNDROME[45] :

Patellar Clunk Syndrome is a complication which is unique to PS TKA. This is due to the scar adherent to the undersurface of the quadriceps muscle or due to the synovium that may get caught in the box of the femoral component at the notch during flexion, and creates the characteristic "clunk" as the knee is extended. This can be avoided by removing the synovium or scar from the under surface of the quadriceps tendon and can be treated by arthroscopic or open debridement.



12. JUMPING OF THE POST IN POSTERIOR STABILIZED KNEES

This complication is unique to the posterior- stabilized knees. PS knees are at risk for "jumping of the post" and locking of the knee when there is a loose flexion gap.

13. SEVERE VARUS OR VALGUS DEFORMITIES[5,8]:

In patients with severe valgus or varus deformity PCL may compound imbalance between the flexion and extension spaces and PCL may be contracted in coronal plane deformities which makes cruciate retention difficult. In a recent study by Scott and Volatile showed that with severe angular deformity in spite of appropriate soft tissue release, the Posterior Cruciate Ligament acts like a tether and impedes proper medial and lateral balancing on the concave side of the deformity. **Laskin et al** in his study with 10 years followup, showed that patients with posterior stabilized prosthesis had better outcome than those wit cruciate retained. **Stern et al** has showed better results with posterior stabilized prosthesis and recommends PS prosthesis in knees with severe deformities.

14. POSTPATELLECTOMY PATIENTS :

Paletta and Laskin in their study reported that Cruciate-Retaining knees have a increased rate of AnteroPosterior instability, more recurvatum and had loss of active extension, compared to Posterior Stabilized knees[48]. They showed that the post and cam mechanism present in the PS knees provides significant stability and increases the lever arm for quadriceps function.

15. BIOMECHANICAL PROPERTY AND KNEE SCORE:

Surgeons who advocate cruciate retention state that posterior cruciate ligament is a biologic stabilizer which is capable of absorbing shearing forces and decreases the stresses at the prosthesis-bone interface. Opponents state that Posterior Stabilized prosthesis improves stair climbing and had higher range of motion and prevents subluxation of the tibia posteriorly. **Dejour et al** reported a significant higher knee scores in patients who underwent Posterior Stabilized TKA than those who underwent Cruciate Retaining TKA[47].

SURGICAL TECHNIQUE

For a successful total knee replacement meticulous planning and evaluation is a must and a neatly performed surgery has a better outcome.

Preoperative Planning:

Pre operatively a detailed history of the patients complaints is obtained regarding the duration of pain,the daily activities affected out of the disease.Any infective focus, varicose vein, DVT must be ruled out. Clinical evidence for any ligamentous instability is also checked. Blood investigations are done to rule out any inflammatory pathology.

A standing full length AP (anteroposterior),lateral x ray was obtained for all the patients .In the radiographs the amount of joint narrowing,any bony deformity was assessed .anatomical and mechanical axis were drawn using the full length x rays and amount of varus or valgus deformity was quantified.

Written valid consent was obtaine for all patients. Preoperatively all the patients were explained about the lifestyle modifications that they have to make ,like avoiding squatting and sitting cross legs after TKR. Pre operative anaesthetic,cardiologist assessment was obtained all patients. Overnight fasting was advised for all patients and preoperative antibiotic prophylaxis was given.

In Operation Theatre:

Patient was put in a supine position. Two bolsters were fixed using plaster to the table for allowing knee flexion of 30 degree and 90 degree. Surgery was done under epidural anaesthesia. Thorough prelimanry wash was given with betadine scrub from the proximal one third of thigh to the foot..High pneumatic tourniquet was applied over the thigh. The limb was draped well ,thoroughly prepared with betadine

Skin incision:

The most commonly used skin incision for total knee arthroplasty is anterior midline incision .Skin incison extends from 4 cm above the patella to 4 cm below the patella.

Retinacular incision

Three types of retinacular incisions can be utilized for total knee Arthroplasty

1) medial parapatellar approach

2) mid vastus and

3) sub vastus.

Medial parapatellar approach is used commonly as this approach can be easily extended or converted to a more extensive traditional approach when additional exposure be necessary. Arthrotomy is performed about 1–2cm above the superior pole of the patella, and extended to the level of the tibial tubercle. Fat pad excision done to facilitate exposure and to improve patellar mobility. Medial and lateral menisci, anterior cruciate is cut, PCL either retained or substituted. Loose bodies and osteophytes are removed and patella everted for adequate visualization, the lateral patellofemoral ligament is incised and posteromedial soft tissue release is done(except for severe valgus knees.

SOFT TISSUE RELEASE

Varus Knee

Varus knee is the most common deformity of osteoarthritis knee.

Order of release :

Varus Knee

1. Deep medial collateral ligament to the posteromedial corner of knee[5]
2. All the osteophytes on femur and tibia[5]
3. Semimembranosus aponeurosis[5]
4. Superficial medial collateral ligament[5]
5. Pes anserinus insertions[5]
6. Posterior Cruciate ligament[5]
7. Strip the periosteum of the tibia distally for an additional 4 to 5 cmif medial contracture still persists.[5]

Valgus Knee[8]

1. Lateral osteophytes
2. Capsular attachments over lateral tibia
3. Lateral patellofemoral ligament
4. Iliotibial band released from gerdys tubercle
5. Popliteus
6. Lateral collateral ligament from femur

7. Posterior cruciate ligament

8. Biceps Tendon of the fibular head

Flexion contracture[5]

1. Posterior osteophytes removal

2. Posterior capsule release

3. Posterior cruciate ligament

4. Tendinous orgins of gastrocnemius

Distal Femoral Resection

Following arthrotomy with an adequate visualisation of both femoral condyles,the knee is flexed to 90 degrees.A drill hole is made at 1 cm above the roof of the intercondylar notch anterior to the orgin of posterior cruciate ligament and slightly medial to the apex of the notch.Canal is overdrilled at the entry point which allows the guide rod to pass easily.

The adjustable intramedullary distal femoral resection guide is connected to the T handle and set to the desired valgus angle(we routinely used a 5^0 degree valgus module for all the twenty cases) by pressing and turning the valgus angle dial.Alignment confirmed with an alignment rod inserted into the jig and necessary correction made if required.

Two resection slots of 0 or +3mm are available for the distal resection. The 0mm slot will resect 9mm from the most prominent part of the contacting distal condyle. If additional distal resection is required, the +3mm slot will resect 12mm. If additional distal resection is required beyond the +3mm slot, resection guide is shifted proximally by utilizing the pin holes.

A saw blade is used for the distal resection through the selected slot. Resected distal femur is checked using a flat instrument called c-guide.

FEMORAL SIZING

Femoral sizing can be done using anterior referencing and posterior referencing. We followed the posterior referencing technique.

Anterior Referencing

Here the anterior cortex serves as the primary reference point. The anterior resection is fixed first and the posterior resection varies with size. In cases where the sizing guide indicates the femoral implant is between two sizes, the **smaller size** should be selected. Choosing the smaller size results in more bone resection from the posterior condyles.

The anterior surface can be raised by adjusting the upper hex screw, from the lowest position to read the next smaller size on the stylus. In raising the anterior surface, the drill holes are also raised by the same amount . As a result, the anterior surface is shifted anteriorly by a distance equal to the amount the A-P dimension of the femur is from the next smaller implant size. Additional resection of the same amount is made from the posterior condyles.

Posterior Referencing

Posterior femoral condyles serves as the reference point for posterior referencing technique. The posterior resection remains constant while the anterior resection varies with respect to the anterior cortex. The posterior resection will therefore be equal the posterior thickness of the prosthesis, resulting in a balanced flexion-extension space. In cases where the sizing guide indicates the femoral implant is between two sizes, the **larger size** should be chosen.

Sizing Guide Procedure

1. Knee is flexed to 90^0 so that the posterior condyles will be assesible.
2. The femoral sizing guide must flush against the distal femur.Ensure that the posterior paddles are contacting the underside of both posterior condyles.
3. Adjustable shims (1-5mm) can be attached to the posterior paddles of the sizing guide in the event rotational alignment is not appropriate due to deficient posterior condyles.

Sizing Procedure: Posterior Referencing (Fixed Posterior Resection):

1. The anterior surface of the sizing guide should be in the lowest level position.
2. Insert two pins through the appropriate holes (L for a left knee, R for a right knee) of the sizing guide to secure the guide and prepare holes for the A-P cutting block.

3. The sizing guide stylus should be positioned in such a way that it contacts the lateral ridge of the anterior femoral cortex (highest point on the anterior cortex of the femur).
4. Note the readings on the shaft of the stylus which indicates the size of the component.
5. If the femur is between sizes, choose the larger size.

Extramedullary Tibial Resection:

With the knee flexed, place the spring loaded arms of the ankle clamp of the extramedullary jig around the distal tibia just above the malleoli. The height of the resection block is adjusted to place the tibial resection block against the proximal tibia. The extramedullary jig is aligned parallel to the medial 1/3 rd of the tibial tuberosity to the axis of the 2 nd metatarsal with the ankle in neutral position. Stylus is affixed to jig so as to cut either 9mm (from unaffected lateral tibial plateau) and the jig is fixed with 2 pins.Tibial cut should be taken at 90 +- 2 degrees to the tibial shaft axis in the coronal plane and neutral or slightly posterior slope in the sagittal plane. Tibial cut is taken with a saw and osteotome and tibial sizing done using a tibial tray.

Femoral Preparation

A-P Femoral Resection

1. Position the fixed spikes on the A-P cutting block into the predrilled holes.

2. Ensure that the cutting block is flush with the resected distal femur. Several holes in the A-P block allow fixation of the block. Place one pin centrally through the middle holes below the quick-connect attachment. For additional stability, a smooth headed pin may be placed through the holes on the medial or lateral side of the block

3. Complete the anterior, posterior and chamfer cuts. The block is designed to allow for angling of the sawblade during the cuts.Cuts are taken in such a way that the anterior chamfer cut is taken at the last as the amount of bone loss will be maximum in anterior chamfer cut.

Spacer block is placed and flexion and extension gap is checked. Ligamentous stability is similarly checked in varus and valgus. In extension the femoral and tibial alignment rods are inserted and checked for mechanical axis alignment.

Trial reduction:

Femoral trail component

Trail femoral copnonent is applied to the resected distal femur and the femoral lock punches are made.

Tibial trail component

1. Attach a quick-connect handle to a stemless trial one size below the femoral component size and place on the cut tibia to assess coverage. As needed, additional sizes should be templated using the stemless trials.
2. Once the appropriate size is determined, pin the medial size of the selected stemless trial with a short headed pin.
3. Place a trial insert into the stemless tibial trial tray and perform a trial range of motion to allow the baseplate to center on the femoral trial. After putting the knee through a trial ROM, the surgeon should note the proper rotation of the trial tibial component on the proximal tibia and mark the tibia for future reference.
4. Using the tibial fin/stem punch, rotational alignment may be set now or at the time of trial placement.

Before cementing the femoral lock punch for the femoral component must be done.

Denervation of patella:

Patellar osteophytes are removed and patellar circumference cauterized. If patella is also to be replaced its thickness is measured with a vernier caliper and a jaw clamp is used to hold and shave the surface of the patella so as to leave 13-15 mm of thickness. Patellar button jig is placed on surface and 3 drill holes made and trial button is placed and patellar tracking is checked. Thorough wash given

Final component implantation:

After clearing all the debris,the raw surfaces of the distal femur and tibia are brought into a clear view by flexing the knee.Bone cement is applied to the femoral and tibial component as well as to the edges of the raw surafces and implant is applied.After applying the trial insert the knee is kept in full extension for the cement to set in.The wound is closed in layers after keeping a drain and knee is immobilised in knee brace.

POSTOPERATIVE PROTOCOL

Post operatively all the patients were put on the same antibiotic(Inj.Cefotaxime and Inj.Gentamycin). DVT prophylaxis was not given to any of the patients. Suture removal done between tenth and twelveth post op day. All the patients were given a temporary immobilisation using knee brace for first 48 hours. First look of the wound and removal of the drain were done on the second post operative day for all the patients. In the immediate post operative period a bolster was kept under the ankle to prevent flexion. Quadriceps strengthening exercises were encouraged from the first post op day. Active knee mobilisation was started on the second or third post operative day as per the patient compliance. Supportive ambulation using walker was allowed on the third post operative day. All the patients were made to fully weight bear by the fifth to sixth post operative day. Suture removal was done between 10 and 12 post operative day and they were discharged between eleventh to twelfth post op day after satisfactory wound healing.

MATERIALS AND METHODS

Inclusion Criteria

In our hospital total knee arthroplasty is being done for osteoarthritis and rheumatoid. This includes varus as well as valgus knees.

1. Osteoarthritis & Rheumatoid arthritis
2. Age> 50 yrs
3. Kellegran and Lawrence score Grade 3 and 4

Exclusion Criteria

1.Age< 50 yrs

2.Minimal degenerative changes(KL I & II)

3.Poor skin conditions

4.Post traumatic arthritis

5.Varicose veins

6.Medically unfit

7.Patients without documents for scheme

Criteria for retaining PCL:

- Structurally intact posterior cruciate ligament
- Fixed flexion deformity of less than 15^0
- Varus of less than 10^0
- Valgus of less than 10^0

Criteria for sacrificing PCL:

- Fixed flexion deformity of more than 15^0
- Valgus or varus more than 10^0
- Structurally contracted PCL
- Technical inability to properly balance PCL.

The period of study is from Jan 2012 to september 2013. Cases operated before June 2012 with atleast 3 months of follow up were taken into study. During the study period 26 knees were replaced in 25 patients. Of them three patients with three total knee replacement lost follow-up one died due to medical(cardiac) cause and two did not turn up for follow up. Others had regular follow up and were taken into study. Final study was on 20 knees in 19 patients which includes 1 bilateral and 18 unilateral cases.

The patients who did not turn for follow-up were excluded from the study. This included five patients with five knees.

Age Group

Range	52 years to 73 years
Mean	58.1 years

Table - 1

Sex Ratio

Sex	**Number**
Male	12
Female	8

Graph - 1

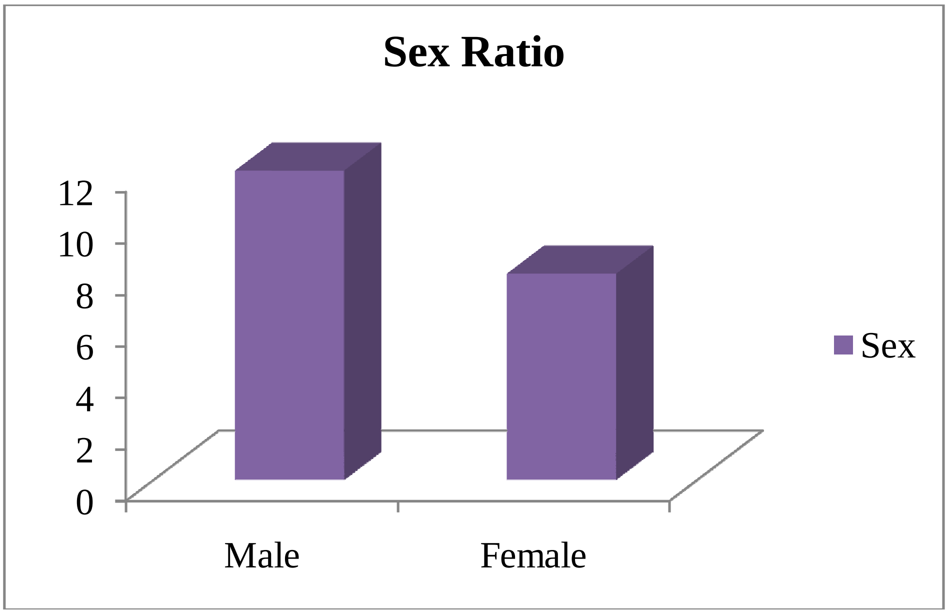


Table - 2

Indication

Disease	Number
Osteoarthritis	19
Rheumatoid Arthritis	1
Others	Nil

Graph – 2

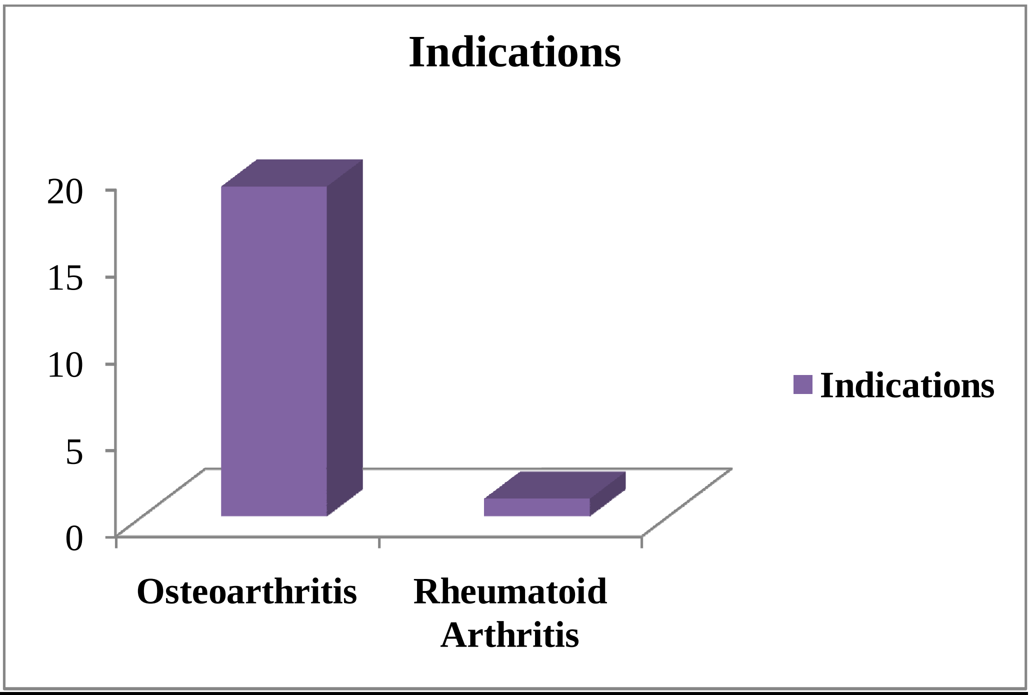


Table - 3

Side

Side	Number
Right	7
Left	11
Bilateral	1

Graph - 3

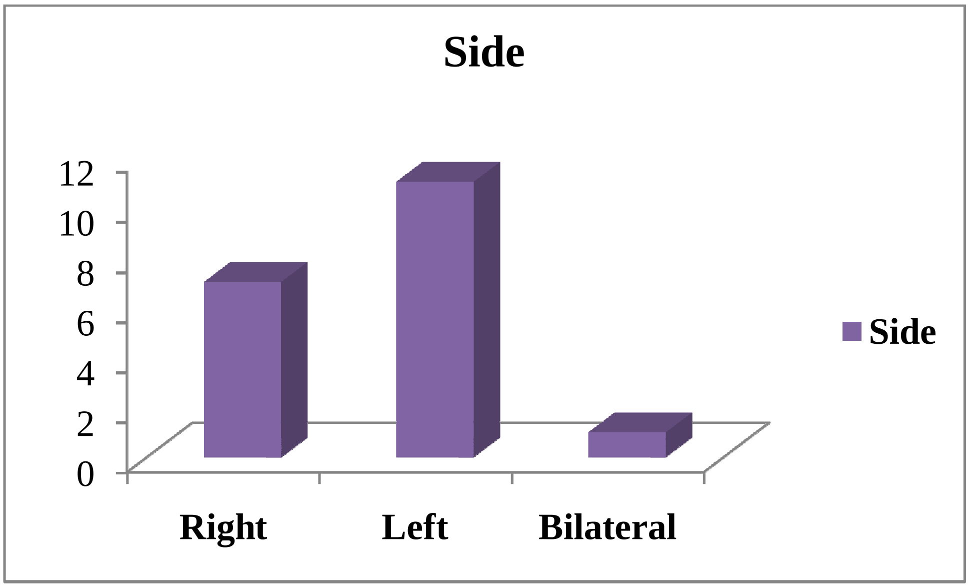
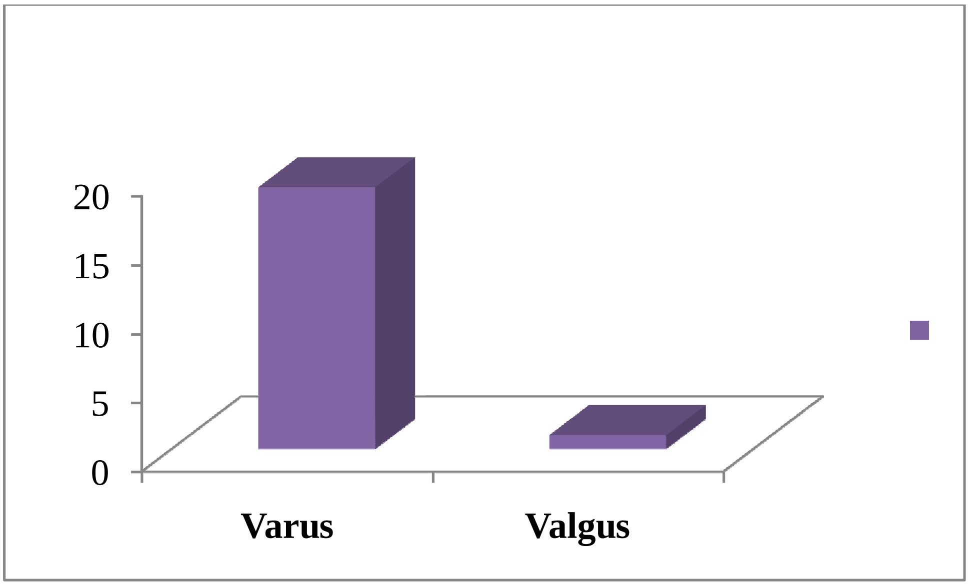


Table - 4

Type of Deformity

Deformity	Number
Varus	19
Valgus	1

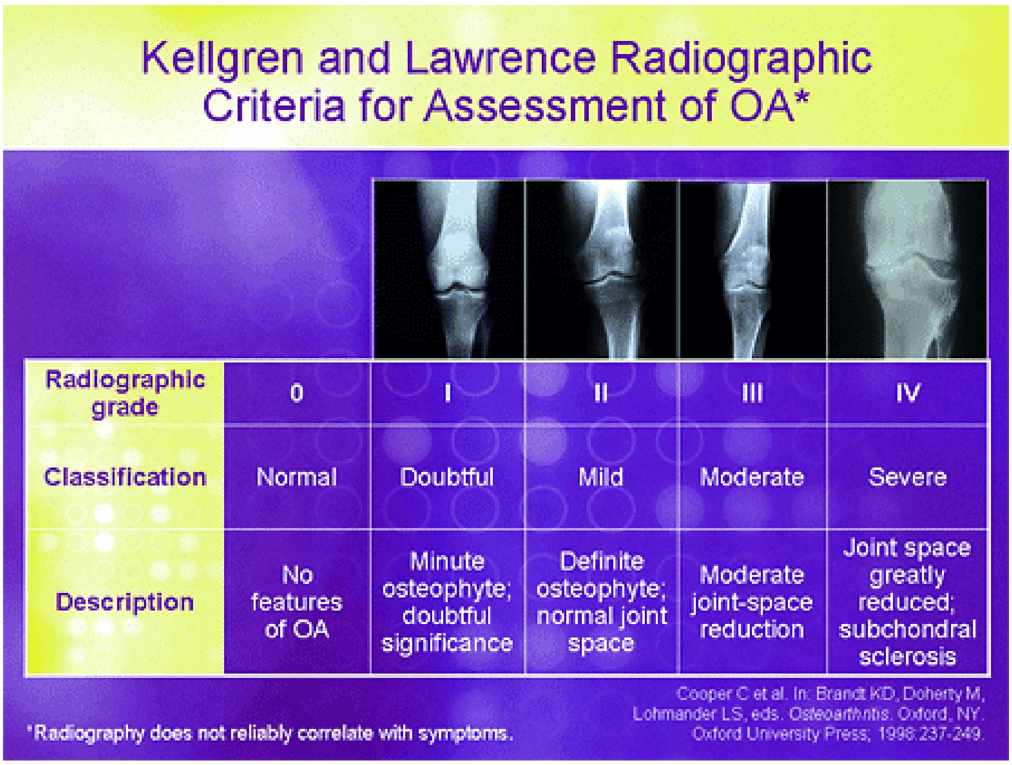
Graph - 4



Preoperatively height and weight of the patients are recorded and the Body Mass Index calculated and graded as per the WHO guidelines.

Scoring system formulated by the WOMAC Score and Functional Knee Score were used to evaluate the patients before and after surgery. Both knee scores and functional scores are calculated with each amounting to a total of 100 points and WOMAC Score with max of 96 points (24questions).

Preoperative full length radiograph from the hip to ankle was taken in all the patients who underwent knee replacement surgery and pre op mechanical axis was drawn and the amout of varus or valgus deformity was quantified. Radiological grading as advocated by **Kellegren and Lawrence** was used to evaluate the severity of the arthritis and graded from I to IV as follows:



Radiographic grade	0	I	II	III	IV
Classification	Normal	Doubtful	Mild	Moderate	Severe
Description	No features of OA	Minute osteophyte; doubtful significance	Definite osteophyte; normal joint space	Moderate joint-space reduction	Joint space greatly reduced; subchondral sclerosis

All the cases were investigated thoroughly and comorbid medical conditions brought under control before surgery. Pre op Haemoglobin of 12 gms% was considered as cut off. Presence of any skin ailments,varicose veins were ruled out prior to surgery. All the 20 cases were performed by 4 different team of surgeons at various period of time during the study period.

All the cases were done under tourniquet control using pneumatic tourniquet. Anaesthesia by either epidural or spinal as per the anesthetist discretion. All cases approached by anterior midline incision and retinacular exposure done by medial parapatellar arthrotomy. Ligament balancing and bone cuts were performed on table depending on the severity of the disease.Bone defect of more than 1 cm was present in one case.A bone graft obtained from the distal femoral bone cut was used to fill the gap. PCL was retained in five patients who had minimal deformities with no flexion contracture pre operatively and PCL was sacrificed in rest of the patients.PCL retaining prosthesis was applied for all the five in whom PCL was retained.Implants for all the twenty cases were of the same manufacturer.Bone cement was used in all the twenty cases.

PCL Reatining/Sacrificing	**Number**
Cruciate Retaining	5
Cruciate sacrificing	15

POST OPERATIVE EVALUATION:

Clinical/functional:

Post operative follow up was done monthly during the intial three months.All patients were evaluated post operatively for the range of movements,relief of pain and scoring done as per Knee Society Knee Score, Knee Functional Score and WOMAC questionnaire was done in all patients after an average of 3 months from the date of surgery.

Case I: PONNUMANI (CS Prosthesis)

Patient name : **Mr. Ponnumani**

Diagnosis : Bilateral Osteoarthritis of Knees with Varus

Pre-op data

Knee score:	Rt 42	Lt 45
Functional knee score:	Rt 46,	Lt 47
Womac score	Rt 65,	Lt 68
KLSCORE:	Rt 2,	Lt 3

Surgery data

Implant used: Lt CR

Post Op Assessment:

Functional

Knee score:	Rt 42 ,	Lt 79
Functional knee score:	Rt 46,	Lt 100
WOMAC Score	Rt 65,	Lt-25

Radiological:

Varus 12

BILATERAL OA KNEE WITH VARUS

PRE OPERATIVE X RAY

POST OPERATIVE X RAYS

POST OPERATIVE CLINICAL PHOTOS

CASE 2 SUDALAIMANI(CR Prosthesis)

Patient name	: **Mr. SUDALAIMANI, 57/M**
Diagnosis	: Bilateral Osteoarthritis of Knees with Varus

Pre-op data

Knee score:	Rt 45,	Lt 46
Functional knee score:	Rt 49,	Lt 50
Womac score	Rt 63,	Lt 62
KLSCORE:	Rt 3,	Lt 3

Preoperative Clinical Picture

Surgery data

Implant used: Lt CR

<u>Post Op Assessment</u>:

Functional

Knee score:	Rt 45 ,	Lt 72
Functional knee score:	Rt 49,	Lt 92
WOMAC Score	Rt 63,	Lt27

POST OPERATIVE X RAY

POSTOP FOLLOW UP 3 MONTHS

CASE 3 PANDIAN (CS PROSTHESIS)

Patient name : **Mr. PANDIAN 54/M**

Diagnosis : Bilateral Rheumatoid Arthritis of Knees with varus

Pre-op data

Knee score:	Rt 38,	Lt 37
Functional knee score:	Rt 42,	Lt 46
Womac score	Rt 65,	Lt 62
KLSCORE:	Rt 4,	Lt 4

Surgery data

Implant used: Rt CS

Post Op Assessment:

Functional

Knee score:	Rt 84,	Lt 37
Functional knee score:	Rt 100,	Lt 18
WOMAC Score	Rt 24,	Lt-62

Preoperative clinical photo

Preoperative Xray

Postoperative X rays

6th Postoperative day

Second month follow up

Case 4 SHAHUL HAMEED (CS)

Patient name : **Mr.SHAHUL HAMEED 54/M**

Knee score :	Rt 47,	Lt 46
Functional knee score:	Rt 40,	Lt 38
Womac score	Rt 64,	Lt 66
KLSCORE:	Rt 3,	Lt 3

Surgery data

Implant used : Lt CR

Postoperative Xrays

Post Op Assessment:

Functional

Knee score:	Rt 47,	Lt 94
Functional knee score:	Rt 40,	Lt 100
WOMAC Score	Rt 64,	Lt66

Walking with walker on the fifth post op day

CASE 5 RAJAGOPAL (CR)

Patient name: **Mr.RAJAGOPAL , 63/M**

Pre-op data

Knee score:	Rt 36,	Lt 38
Functional knee score:	Rt 38,	Lt 45
Womac score	Rt 67,	Lt 50
KLSCORE:	Rt 3,	Lt 3

Surgery data

Implant used: Rt CR

Post Op Assessment:

Functional

Knee score:	Rt 69,	Lt 38
Functional knee score:	Rt 100,	Lt 45
WOMAC Score	Rt 27,	Lt50

Postoperative Xrays

Third month follow up

RESULTS

All the 20 cases which had regular follow up for taken into the study and the average follow up was from a minimum of 3 months to 18 months.

We had the following observations:

Among the 20 cases which received total knee replacement using a cruciate retaining prosthesis we retained Posterior cruciate ligament in 5 patients and in the rest it was sacrificed.

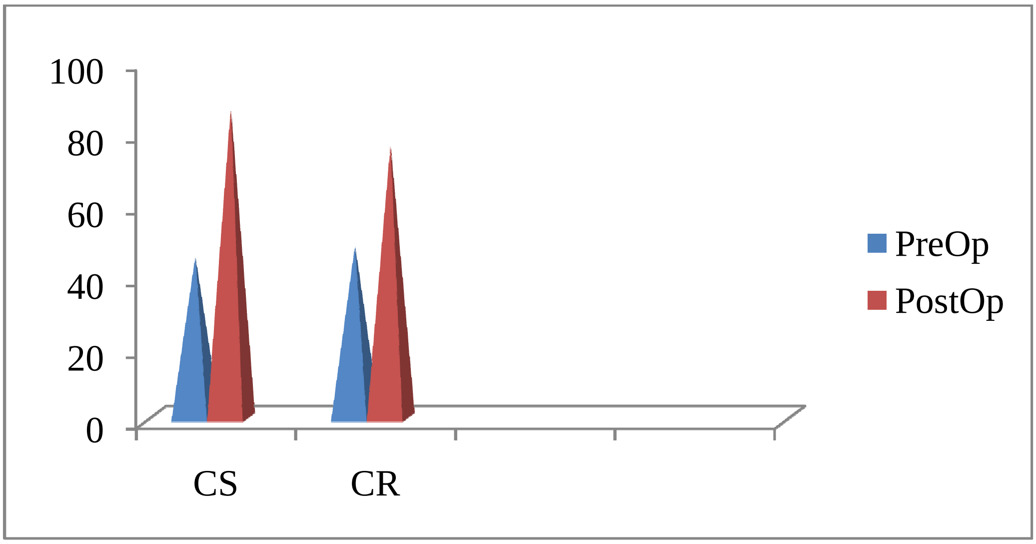
The functional outcome between the posterior cruciate retaining and the cruciate sacrificing groups were compared using the American knee society scoring and the functional knee score and WOMAC Questionnaire and the following observations were made.

1. Pain:

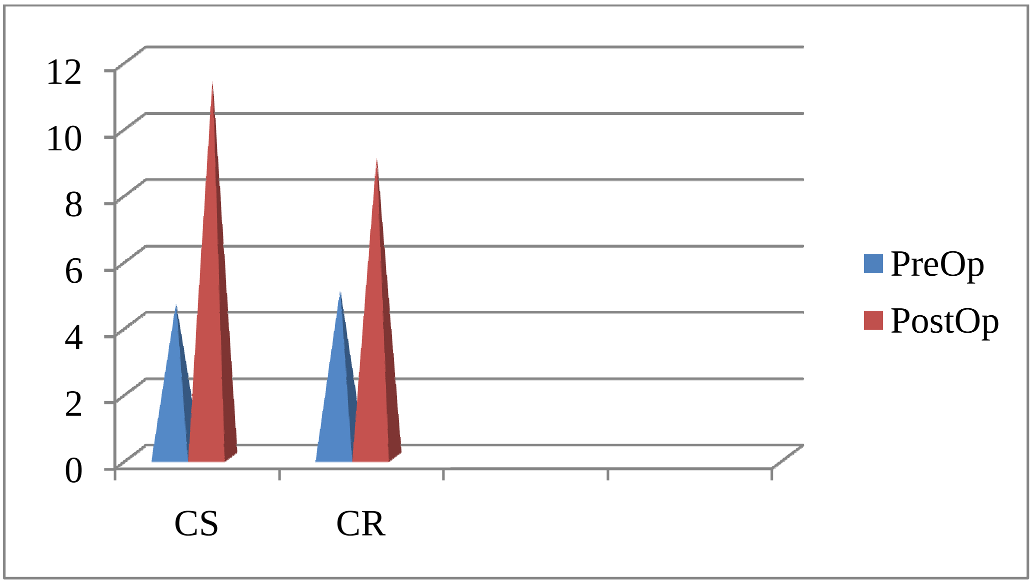
Overall all the patients, in both the groups had great improvement in the knee scores. The pain score (including stair climbing) in the Posterior cruciate sacrificing was on average 42.6 (out of 50) and that of Cruciate Retained group was 37.

Stair climbing score was11 .3(out of 15) and 9in the PCL Sacrificing and Retaining groups respectively as compared to the preoperative score of 4.6 and 5

PAIN SCORE

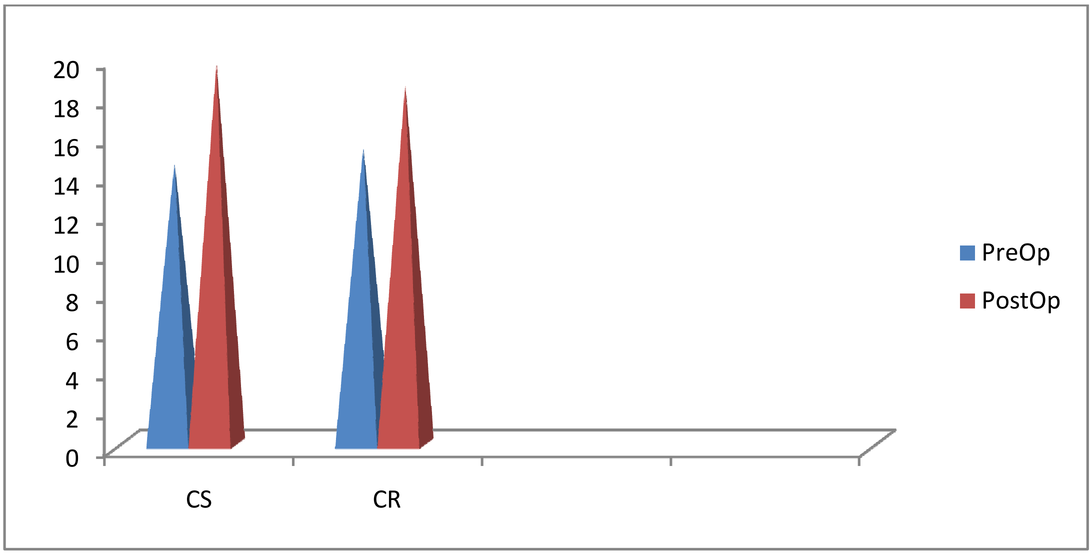


STAIRCLIMBING



2. Range of Movements:

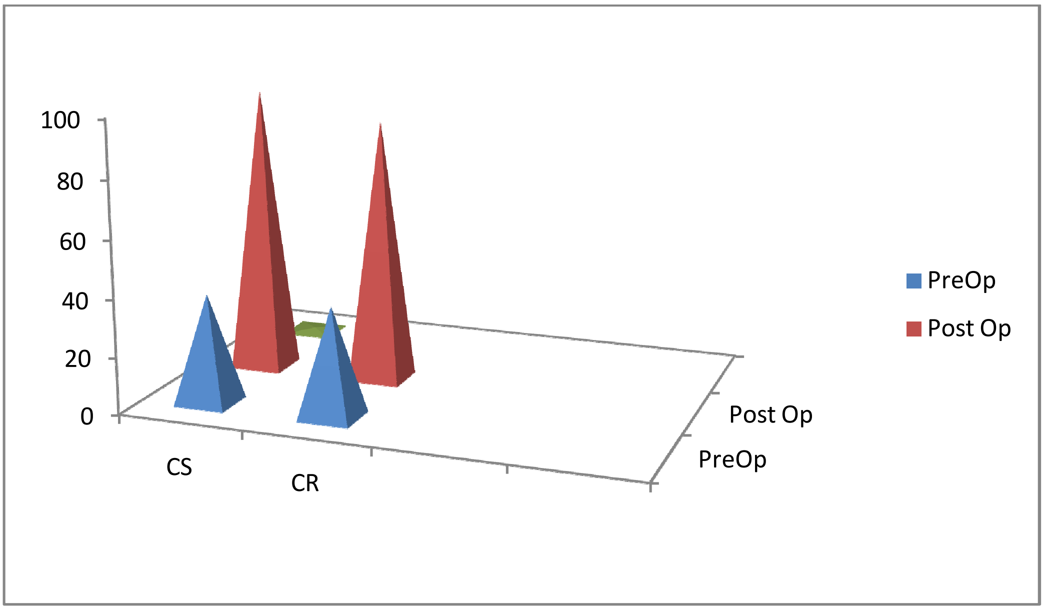
The mean range of movements in the CS and CR groups had a great improvement with postoperative scores 19.5(max 25) and 18.4 in PCL sacrificing and retaining groups respectively.



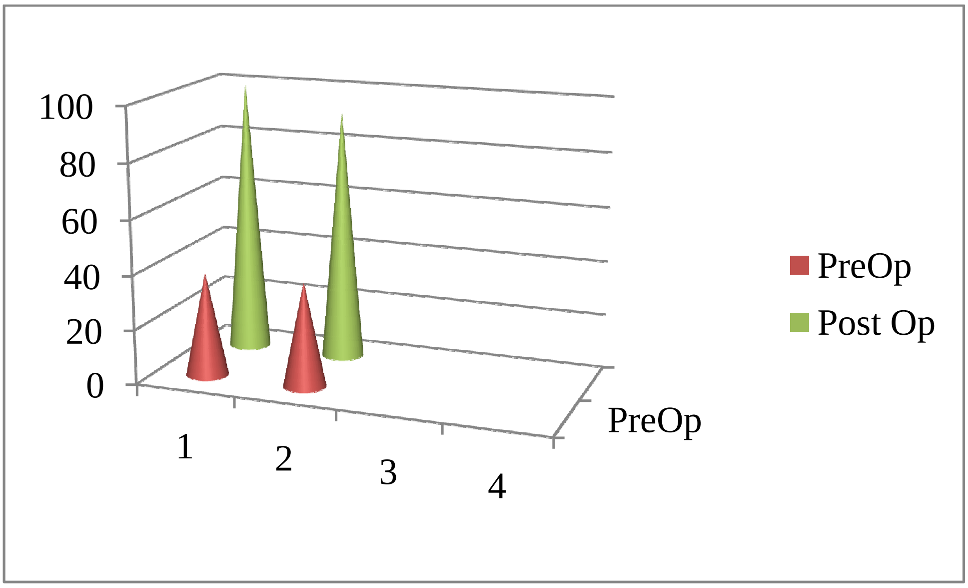
3. **Total Knee Scores**:

The overall average knee score was 85.8 for Posterior Cruciate Sacrficing and 75.6 for the Cruciate Retained patients as compared to the pre operative score of 43.4 and 38. Functional Knee Score was 99.6 and 91.6 for CS and CR groups respectively.The preoperative Functional knee score was 37.8 and 38 in these groups The WOMAC Score also showed a marked improvement from 66.3 to 24.6 in cruciate sacrificing groups & 27.4 for CS and CR respectively.

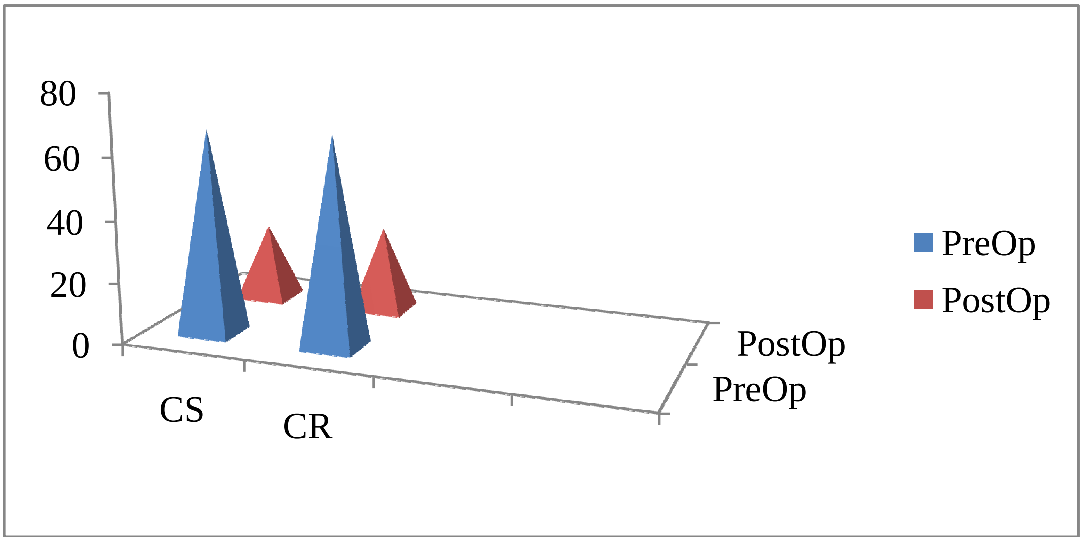
FUNCTIONAL KNEE SCORE



KNEE SCORE



WOMAC SCORE



DISCUSSION

Total knee replacement, is a surgical procedure to replace the weight-bearing surfaces of the knee joint to relieve pain and disability. It is most commonly performed for osteoarthritis and also for other knee diseases such as rheumatoid arthritis and psoriatic arthritis . In patients with severe deformity from advanced rheumatoid arthritis, trauma, or long standing osteoarthritis, the surgery may be more complicated and carry higher risk.

The pioneer of knee replacement surgery was Leslie Gordon Percival Shiers ; his original papers were published in the Journal of Bone and Joint Surgery in 1954. Shiers refused to patent his invention, and demonstrated the operation throughout the world, inviting other surgeons to improve upon his original idea. Followinng John Charnleys's success with hip replacement in the 1960s attempts were made to design knee replacements. Frank H. Gunston and Leonard Marmor were pioneers in North America. Marmor's design allowed for unicompartmental operations but did not always last well. In the 1970s the "Geometric" design, and John Insall's Condylar Knee design, found favor. The history of knee replacement is the story of continued innovation to try to limit the problems of wear, loosening and loss of range of motion.

Most common indication for total knee replacement is osteoarthritis. Various factors are associated with the onset and progression of clinical osteoarthritis. These include genetic factors, age, sex, obesity, occupation, abnormal loading of the joint as in kneeling, squatting and cross legged sitting.

The mean age of our patients who had osteoarthritis and got TKR done was 58. It is much higher than the data available from the western population. 50 % of our patients were well within the normal range of body mass index of <25 kg/m^2.

The earlier onset of osteoarthritis in individuals with normal range of BMI is explained by the habit of kneeling, squatting, cross legged sitting practiced by the population in this part of the world.

58% of our patients had Grade IV osteoarthritis with complete obliteration of joint space at the time of initial presentation.

Various scoring system are in vogue to assess the outcome of Total Knee Arthroplasty namely The American Knee Society Score, Function Knee Society Scoring, Western Ontario and McMaster OA index (WOMAC), The Hospital for Special Surgery Rating System Knee injury and Osteoarthritis Outcome Score (KOOS), Oxford 12-item Knee Questionnaire.

All the 20 patients in our study were evaluated both preoperatively and post operatively. Post operatively they were divided into 2 groups depending upon whether the cruciate ligament was retained or sacrificed. The Functional outcome was evaluated using the Knee Society Score, the Functional Knee Score and WOMAC questionnaire score.

I. Functional outcome:

Analyzing the functional outcome it was found that all the patients in both the groups had significant improvement in their knee score and the functional knee score. On comparision between the two groups ,in those patients in whom the cruciate ligament was sacrificed had an average knee score of 85.8 and a Functional Knee Score of 99.6 ,whereas in whom the posterior cruciate ligament was retained the knee score was 75.6 and functional score was 91.6.

The results were analysed statistically using SSPS -17 (Statistics Package for Social Sciences) software and using

- chi-square for discrete variables
- 't' test for continous variables
- bivariate correlation to find out measure of agreement were done

Pain:

All patients in the study in both the groups had marked improvement in pain score from their pre-operative level, the pain score of knee society score were analysed statistically we got the following values.

Sl No	Category	Group	No	Mean	SD	S.E of Mean	P value	Significance
1	Walk	CS	15	31.00	2.070	.535	.013	Significant
		CR	5	34.00	2.236	1.000		
2	Stairs	CS	15	11.00	2.070	.535	.013	Significant
		CR	5	14.00	2.236	1.000		
3	Total pain score	CS	15	42.00	4.140	1.069	.013	Significant
		CR	5	48.00	4.472	2.000		

II. Range of movements:

We were able to achieve a flexion of 100 to 110^0 in all our patients and stastistically there was no much difference between CR and CS groups.

Type	No	Mean	SD	S.E of Mean	P value	Significance
CS	15	18.47	.990	.256	.081	NS
CR	5	.548	.548	.245		

TOTAL KNEE SCORE

	Type	N	Mean	S.D	S.E of Mean	p value	Significance
TKS	CS	15	85.80	5.267	1.360	.004	HS
	CR	5	75.00	6.124	2.739		

FUNCTIONAL KNEE SCORE

	Type	N	Mean	S.D	S.E of Mean	p value	Significance
FKS	CS	15	97.87	3.739	.965	.866	NS
	CR	5	98.40	3.578	1.600		

WOMAC SCORE

	Type	N	Mean	S.D	S.E of Mean	p value	Significance
WOMAC SCORE	CS	15	24.60	.737	.190	.000	HS
	CR	5	27.40	.548	.245		

The pain score showed a marked improvement in all the patients with a average of 42.6 in CS group as compared to 37 in CR group. Statstical analysis revealed a significant difference in p value for all the variables of pain score (walking,climbing which was in favour of the cruciate sacrificing group signifying that they had a better improvement in pain score.

Analysing the total Knee Scores, the average Knee Society Score for the PS group was 85.80 and that of CR group was 75.60 and statistical analysis revealed a significant difference in the the p-value in favour of Cruciate Sacrificing Prosthesis signifying that **Cruciate Sacrificing Prosthesis has better functional outcome.**

The functional knee society also showed a marked improvement in all patients,for CS group FKS was 99.6 and for CR group it was 91.6.Statistically there was no significant difference.

The WOMAC Score also showed a marked improvement.In CS groups it was 24.6 and in CR it was 27.4.Statistitical analysis showed a highly significant **difference in favaour of cruciate sacrificing prosthesis**.

And when the three scoring systems were evaluated in our study we found a good agreement between each scoring system with one other.

Correlation between KSS, FKS &WOMAC

		Total KS	Func KS	WOMAC
KSS	Pearson		-.102	-.511*
	P value		.670	.021
Func KS	Pearson	-.102		.041
	P value	.670		.863
WOMAC	Pearson	-.511*	.041	
	P value	.021	.863	

*Correlation is significant at .05 level.

- **All patients had marked improvement in their knee society score and the increase was attributed to pain score and stair climbing.**
- **Functional knee score showed an excellent improvement in all the patients.**
- **Womac score also showed marked improvement with a significant improvement in patients in whom posterior cruciate ligament was sacrificed.**
- **There exists a good degree of agreement between the knee society score, functional knee score and WOMAC score.**

CONCLUSIONS.

1. **Total Knee Arthroplasty in patients in whom posterior cruciate ligament was sacrificed was found to have a better functional outcome as compared to the retaining group,which can be mainly attributed to the persistence of flexion deformity in cruciate retaining group.**

2. **In Indian scenario where knee replacement is done at a late stage of osteoarthritis ,sacrificing the contracted posterior cruciate ligament has better outcomes as compared to retaining it.**

3. **A limitation of our study was that we have used deep dished cruciate retaining prosthesis (which was the only implant available to us in scheme) for all the 20 patients.**

4. **Finally our study is in a small number of cases with short duration and further follow up is necessitated.**

ANNEXURE – II
KNEE SOCIETY KNEE SCORE

Pain	**50 (Maximum)**
Walking	
None	35
Mild or occasional	30
Moderate	15
Severe	0
Stairs	
None	15
Mild or occasional	10
Moderate	5
Severe	0
R.O.M.	**25 (Maximum)**
For each 5º= 1 point	
Stability	**25 (Maximum)**
Medial/Lateral	
0-5 mm	15
6-10 mm	10
> 10 mm	5
Anterior/Posterior	
0-5 mm	10
6-10 mm	8
> 10 mm	
Deductions	
Extension lag	
None	0
<5 degrees	-2
5-10 degrees	-5
>11 degrees	10
Fixed Flexion Deformity	
< 5 degrees	0
6-10 degrees	-3
11-20 degrees	-5
> 20 degrees	-10
Malalignment	
5-10 degrees	0
(5º = -2 points)	
Pain at rest	
Mild	-5
Moderate	-10
Severe	-15

Total Knee Score 100 (Maximum) =

ANNEXURE - III

FUNCTIONAL KNEE SCORE

Walking		
Unlimited	55	
10-20 blocks	50	
5-10 blocks	35	
1-5 blocks	25	
< block	15	
Cannot	0	
Stairs Up		
Normal	15	
Hands balance	12	
Hands pull	5	
Cannot or bizarre	0	
Stairs Down		
Normal	15	
Hands balance	12	
Hands hold	5	
Cannot or bizarre	0	
Chair		
Normal	15	
Hands balance	12	
Hands pull	5	
Cannot	0	
Functional Deductions		
Cane	-2	
Crutches	-10	
Walker	-10	
Functional Score	**100 (Maximum) =**	

ANNEXURE - V

The Western Ontario and MacMallister Osteoarthritis index

(WOMAC score)

It is a questionaire completed by the patient without the help or intervention of the health care provider. It is based on points. It consists of 24 questions, 5 evaluate pain, 2 evaluate stiffness and 17 evaluate function . The Patient answers each , question with the choice of none, mild, moderate, severe or extreme. And these ansers carry a pointsof 0,1,2,3and 4 respectively and totaling done. Unlike the KSS a high scorerepresents a poor result. The questions asked are as follows,

Section A

How much pain do you have ?

Walking on a flat surface

Sitting/lying

Standing upright

Going up or down stairs

At night while at bed

Section B (Stiffness)

How severe is your stiffness after

First wakening in the Morning

Sitting, lying or resting later in the day

Section C (Function)

What degree of difficulty do you have with

Lying on bed

Rising from bed

Sitting

Rising from sitting

Standing

Waking on flat surface

Getting in/out of toilet

Getting in/out off bath

Ascending stairs

Descending stairs

Putting on stockings/socks

Taking out stockings/socks

Getting in/out of car

Going shopping

Light domestic duties

Heavy domestic duties

ANNEXURE VI

PROFORMA

Name: **Age :** **Sex: M/F** **Hospital Number:**
Occupation:
Address:

D.O.A:
D.O.S:
D.O.D:

Brief history:
Past Medical History:
Past Treatment History:

Clinical Examination:
General survery:
Build:
Weight:
Height:
Local examination:
Inspection:
Findings:
Palpation:
Movements:
Measurments:
Pre Op Radiologic Findings:
Pre Op Knee Score:
Pre Op KL Score:
Pre Op WOMAC Score:
Surgical Data:
Side:
Prosthesis used:
Approach:
Duration of surgery:
Amount of blood loss:
Post Op period:
DT removal:
Suture removal:
POST OP ANALYSIS:
Knee Society Score:
Functional Knee Score:
WOMAC Score:

Complications:

ANNEXURE - VII

CONSENT FORM

Name of the patient;_________________________ Date:__________

S/W/D Of:__________________________________

Theses No:_____Address:______________________________

______________________________________.

Phone No:

1. I,____________________________ S/W/D Of:___________________ , resident of ____ Have been informed by the doctor that the clinical diagnosis of my disease is ____

2. I have been further informed by the doctor that the treatment planned for my disease is_________________________________.

3. I have been given the options to ask for any second opinion regarding the diagnosis and treatment.

4. I have been informed that after surgery, I will not be able to squat on the ground and sit cross legged.

5. The risks of the surgery have been discussed with me in the language I understand. The major risks which have been discussed include :

    A: Infection

B: Deep Vein Thrombosis and Pulmonary Embolism

C:Anaesthetic Risks

6. I have been given the opportunity to ask all questions and I have been satisfactorily answered
7. I am aware that in the practice of medicine , other untoward/unexpected risks or complications not discussed may occur. I further understand that during the course of the proposed surgical procedure , unforeseen conditions may be revealed necessitating the performance of additional rectifying /modifying surgery.
8. The translation of the above has been made explained to me in the language I best understand

Date of surgery: Signature Of The Patient/Authorizing Person(With Relation)

Witness 1:

Witness 2:

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ANNEXURE - I

MASTER CHART 1

PRE OPERATIVE DATA

Sl No	Name	Age	Sex	Weight	Height	BMI*	Indication	Side	Deformity	ROM*	Climbing stairs	KL* Score Preop	KS * Score pre op	Preop FS*	Womac score
1	**PONNUMANI**	73/M	M	158	62	24.83	OA	L	Varus	14	5	3	46	49	65
2	**SUBBAMMAL**	60/F	F	158	62	24.83	OA	R	Varus	16	5	4	44	50	67
3	**RAJESWARI**	53/F	F	160	55	21.48	OA	L	Varus	16	5	4	48	49	68
4	**PETCHIAMMAL**	58/F	F	160	55	21.48	OA	L	Varus	15	5	4	40	34	65
5	**SUDALAIMANI**	57/M	M	157	68	27.58	OA	L	Varus	16	5	3	36	28	69
6	**HAMEEDHA**	56/F	F	157	68	27.58	OA	L	Varus	14	5	4	38	25	70
7	**PANDIAN**	54/M	M	152	55	23.80	OA	R	Varus	14	0	4	46	49	65
8	**AMMAPONNU**	64/F	F	157	78	31.64	OA	R	Varus	16	5	4	36	32	67
9	**NAMBI**	66/M	M	157	78	31.64	OA	R	Varus	16	5	4	36	30	66
10	**THANGAVEL**	55/M	M	156	76	31.22	OA	L	Varus	16	10	4	37	30	66

11	**RAJAGOPAL**	61/M	M	157	81	32.82	OA	L	Varus	15	5	3	36	38	67
12	**KRISHNASAMY**	54/M	M	154	79	20.66	OA	R	Varus	15	5	3	44	38	65
13	**BAMA**	52/F	F	152	82	35.49	OA	L	Varus	15	5	4	38	40	69
14	**GOMATHI**	53/F	F	158	71	28.44	OA	L	Valgus	16	0	3	46	36	70
15	**PAULRAJ**	50/M	M	164	60	22.30	OA	L	Varus	16	5	3	48	37	70
16	**VALLIAMMAL**	49/F	F	154	53	22.34	OA	R	Varus	15	5	3	44	48	65
17	**MOHAMMED MOYDEEN**	70/M	M	154	53	22.34	OA	L	Varus	16	5	4	46	48	64
18	**SUDALAI**	73/M	M	155	70	29.13	OA	R	Varus	16	5	4	38	34	67
19	**NARAYANASAMY**	71/M	M	149	61	27.47	OA	R	Varus	16	5	4	46	40	63
20	**SHAHUL HAMEED**	54/M	M	149	61	27.47	OA	L	Varus	15	5	4	47	40	64

*BMI - Body mass index

*ROM - Range of movements

*KL - Kellegren Lawrence

*KS - Knee Society Score

*FS - Functional Knee Score

MASTER CHART 2

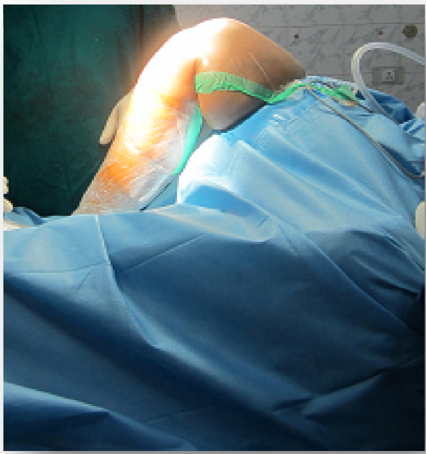
FUNCTIONAL ASSESMENT

Sl no	Name	Side	Type	PainScore			ROM	Instability			Deductions				KL	KS	Functional KS	WOMAC
				Stairs	Climbing	Total		ML*	AP*	TOTAL	Extension LAG	Flexion Contracture	Malalignment	Pain at Rest	Score	Score	Score	Score
1	**PONNUMANI**	L	CS	30	10	40	19	15	10	25	0	0	0	-5	III	79	100	25
2	**SUBBAMMAL**	R	CS	30	10	40	20	15	10	25	0	-3	0	-5	II	85	100	24
3	**RAJESWARI**	L	CS	35	15	50	20	15	10	25	0	0	0	-5	III	90	94	25
4	**PETCHIAMMAL**	L	CS	30	10	40	19	15	10	25	0	0	0	0	IV	84	92	24
5	**SUDALAIMANI**	L	CR	35	15	50	20	15	10	25	0	0	0	-5	II	72	100	27
6	**HAMEEDHA**	L	CR	35	15	50	20	15	10	25	0	-3	0	-5	II	71	100	27
7	**PANDIAN**	R	CS	30	10	40	18	15	10	25	0	0	0	0	II	84	92	24
8	**AMMAPONNU**	R	CS	30	10	40	19	15	10	25	0	0	0	-5	III	79	100	24
9	**NAMBI**	R	CR	35	15	50	19	15	10	25	0	0	0	0	III	80	92	28
10	**THANGAVEL**	L	CS	30	10	40	18	15	10	25	0	0	0	0	III	85	90	25
11	**RAJAGOPAL**	L	CR	30	10	40	19	15	10	25	0	0	0	0	II	69	100	27
12	**KRISHNASAMY**	R	CR	35	15	50	19	15	10	25	0	-3	0	-3	II	83	100	28
13	**BAMA**	L	CS	30	10	40	18	15	10	25	0	0	0	0	III	85	100	24
14	**GOMATHI**		CS	30	10	40	17	15	10	25	0	0	0	0	IV	85	100	24

15	**PAULRAJ**	L	CS	30	10	40	17	15	10	25	0	0	0	0	III	85	100	25
16	**VALLIAMMAL**	R	CS	35	15	50	17	15	10	25	0	0	0	0	II	94	100	26
17	**MOHAMMED MOYDEEN**	L	CS	35	15	50	18	15	10	25	0	0	0	0	II	95	100	24
18	**SUDALAI**	R	CS	30	10	40	19	15	10	25	0	-3	0	-3	III	79	100	25
19	**NARAYANASAMY**	R	CS	30	10	40	19	15	10	25	0	0	0	0	II	84	100	26
20	**SHAHUL HAMEED**	L	CS	30	10	40	19	15	10	25	0	0	0	0	III	94	100	24

*** ML - Medio lateral**

*** AP - Antero posterior**

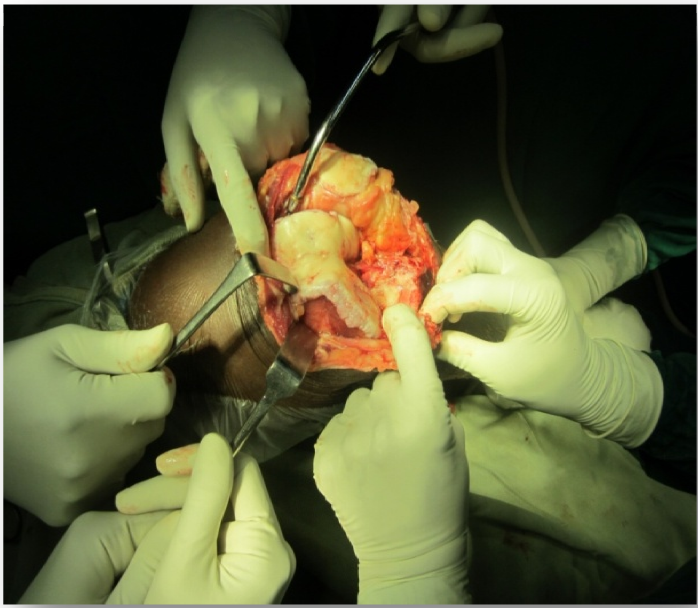


Draping and positioning of the knee

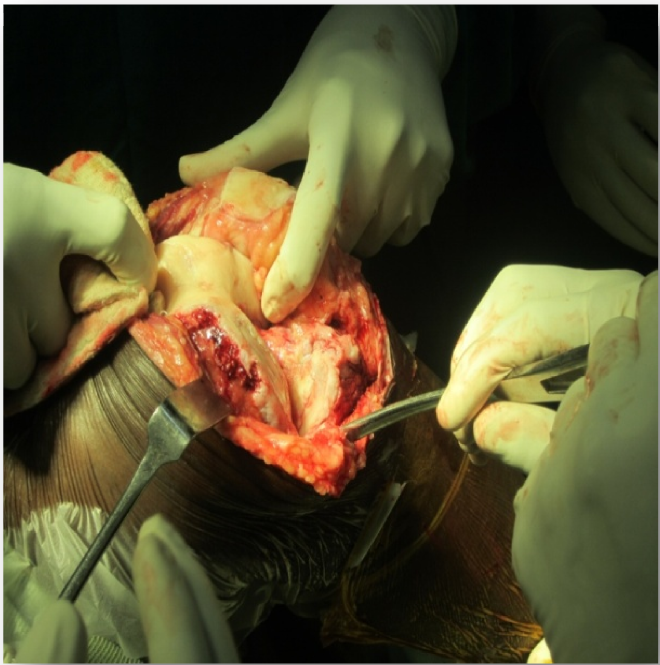
Exaguating and application of tourniquet

Skin incision- Anterior midline incision

Medial parapatellar incision

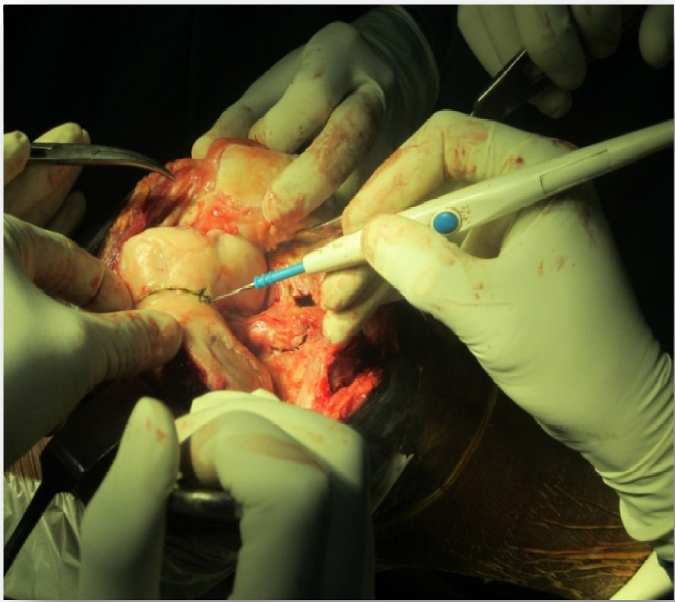


Femoral articular surface after removal of osteophytes

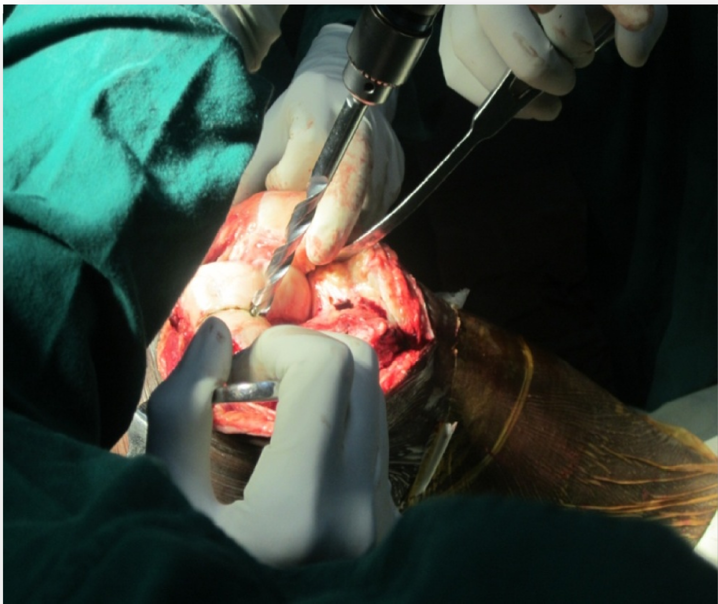


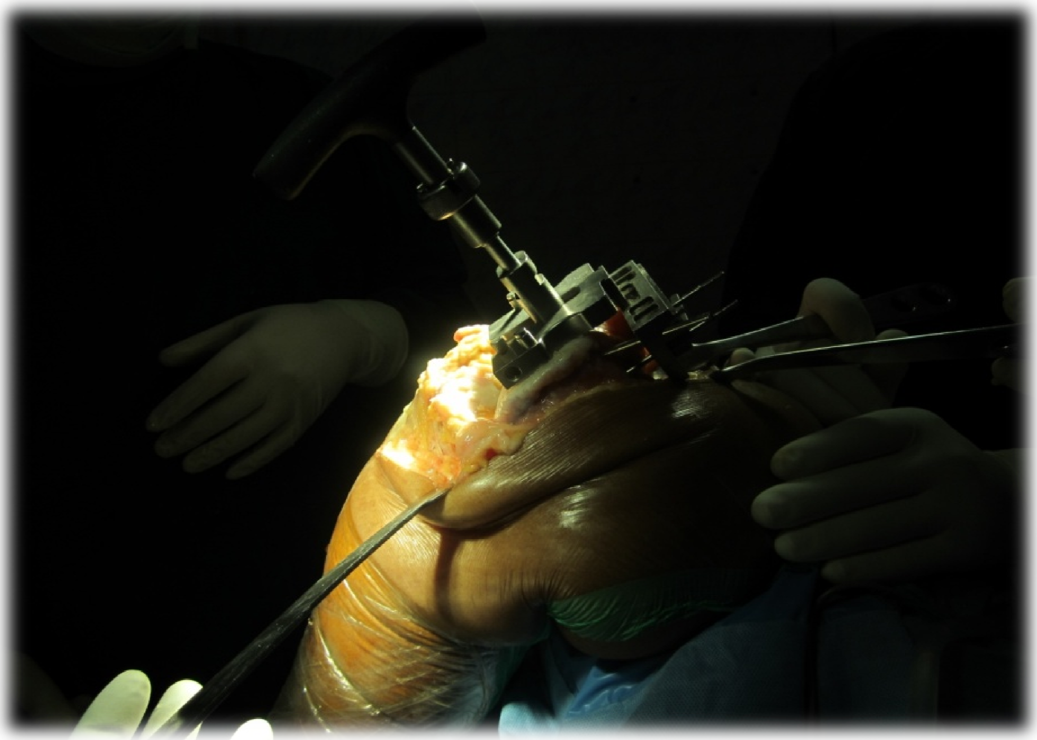
After the removal of anterior horn of both menisci

Marking the whiteside s line

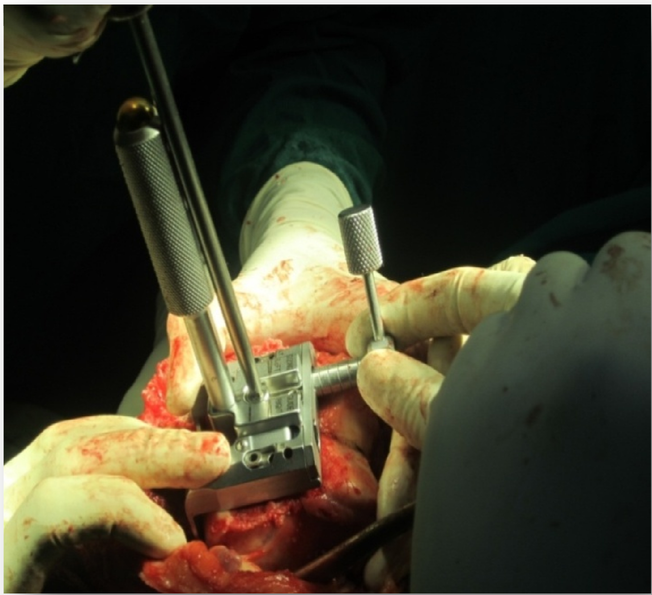


Drill hole made in femoral canal

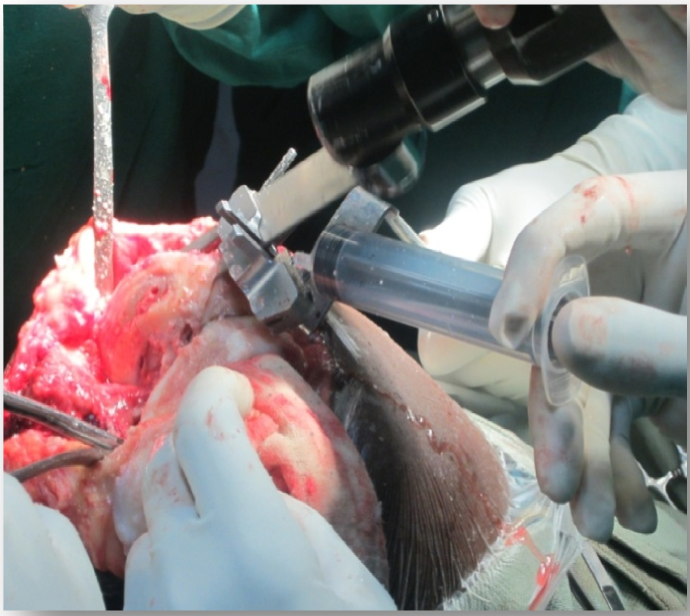




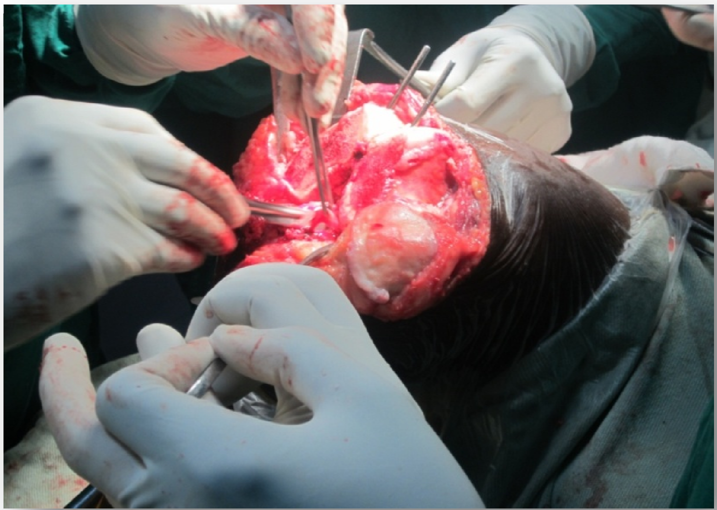
<u>Distal femoral cutting guide assembled with distal alignment guide in 5^0 valgus.</u>



Sizing-posterior referencing

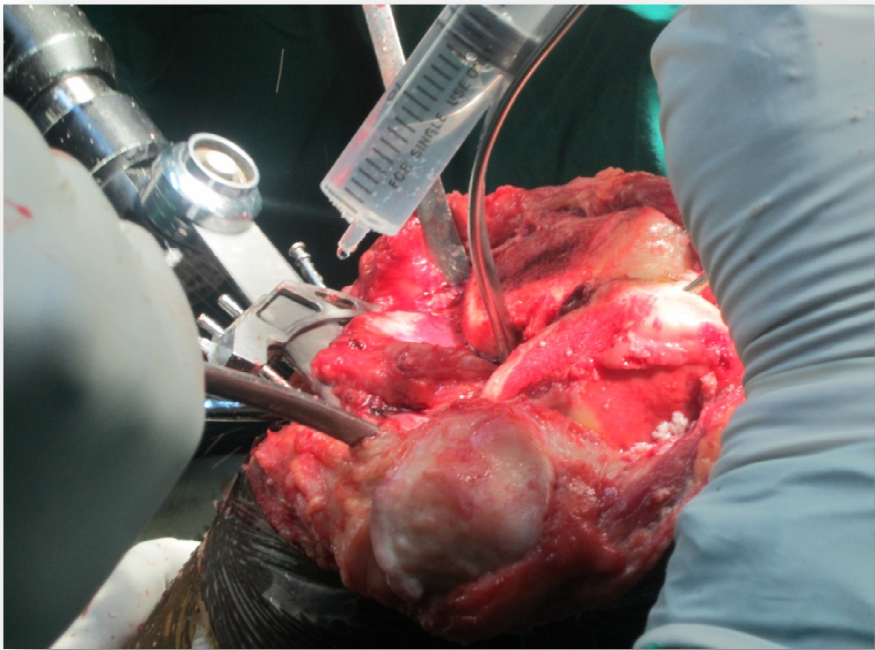


<u>Distal femoral cut</u>

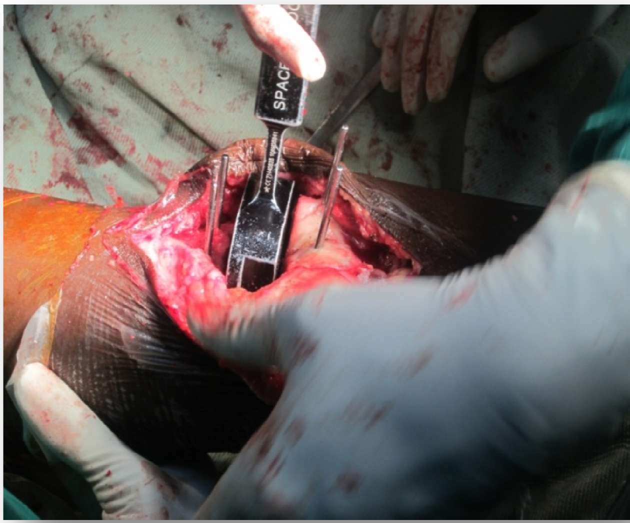


<u>Removal of the resected condyle</u>

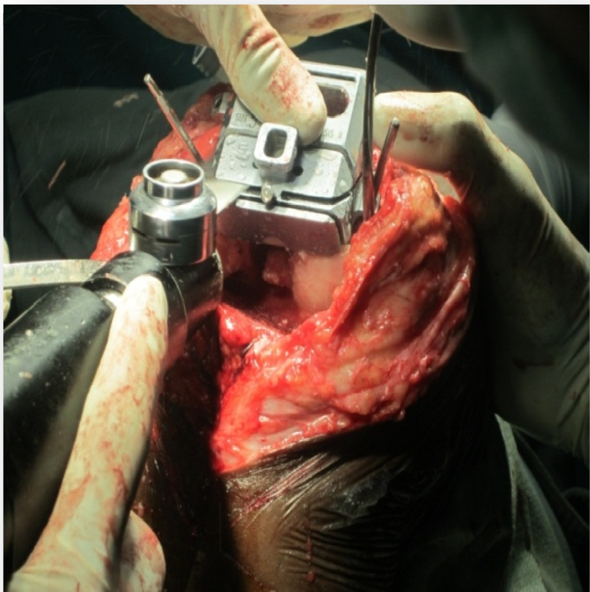
<u>Extramedullary tibial alignment</u>



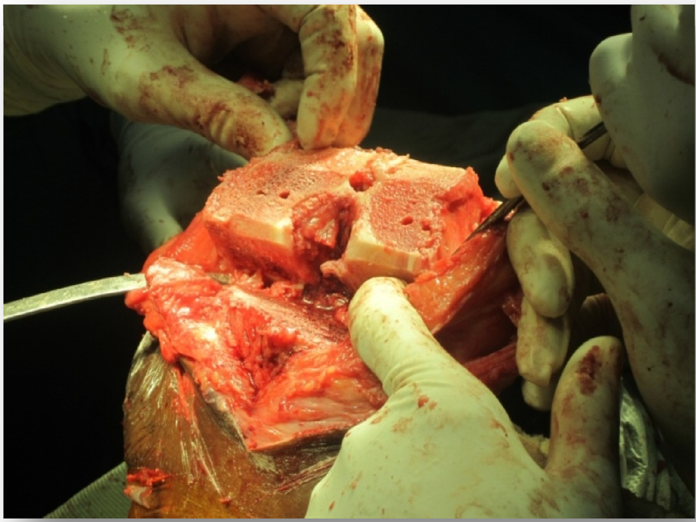
<u>Tibial cut taken</u>



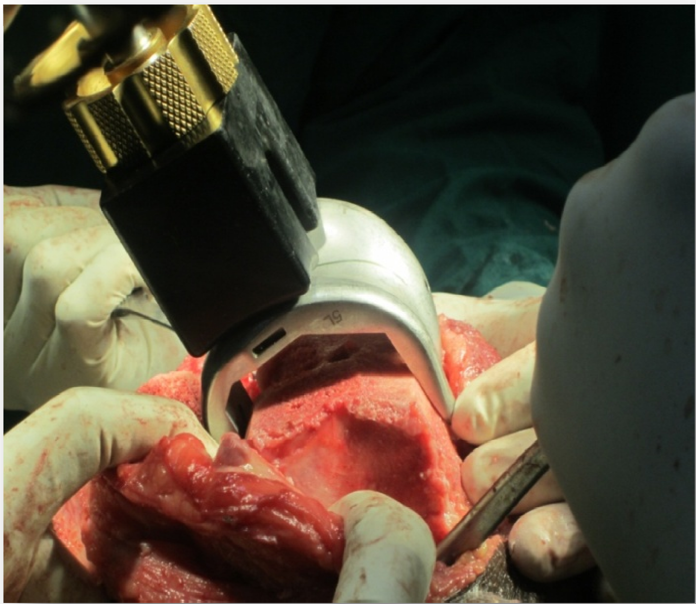
Checking extension gap



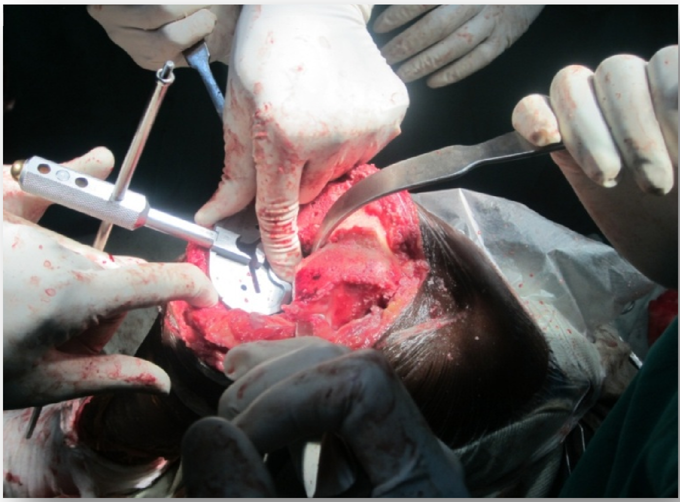
Posterior chamfer cut



<u>Shape of the distal femur after cuts</u>

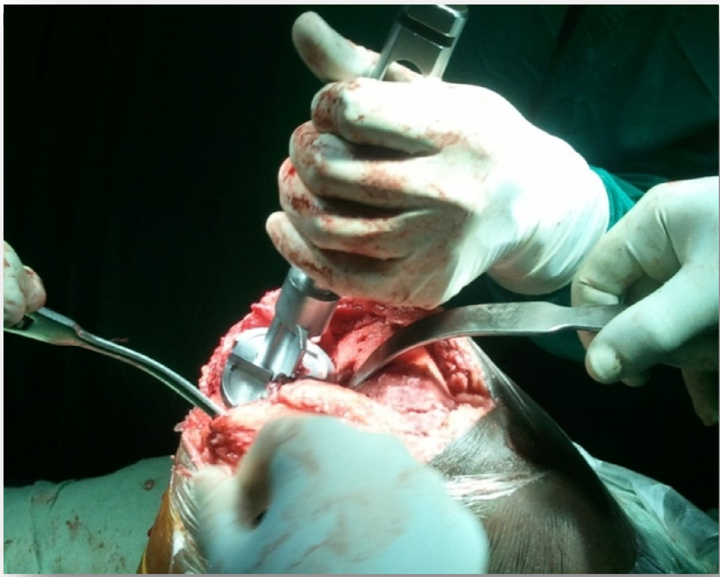


<u>Femoral trial</u>



<u>Tibial sizing with tibial base plate</u>

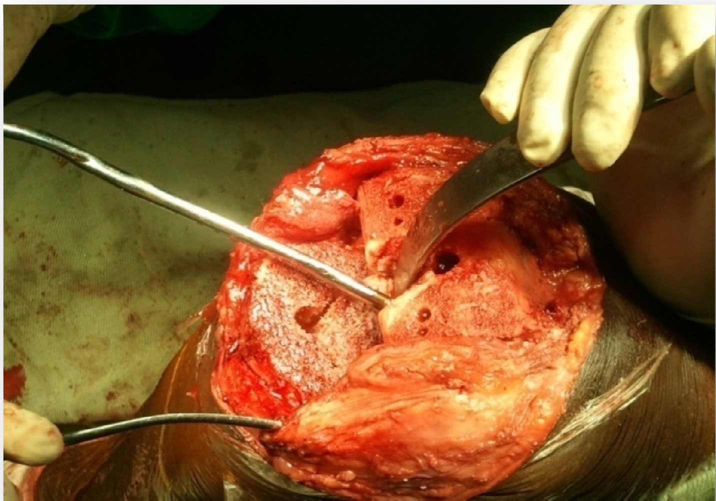
<u>Trailing the articular insert with tibial and femoral trial in situ</u>



<u>Final preparation using Finn punch</u>

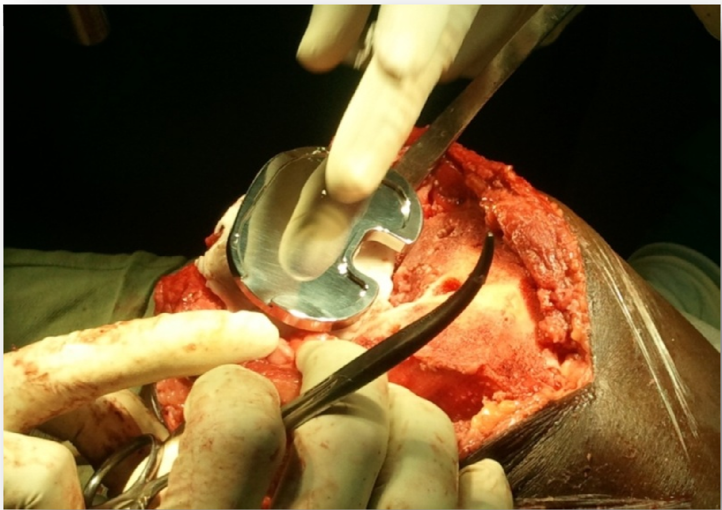
<u>Denervation of the patella</u>

Femoral and Tibial components

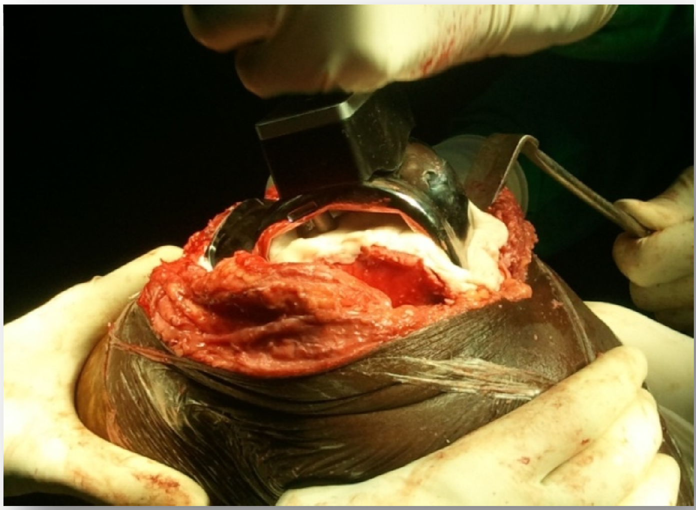


Femoral and tibial surfaces before application of implant

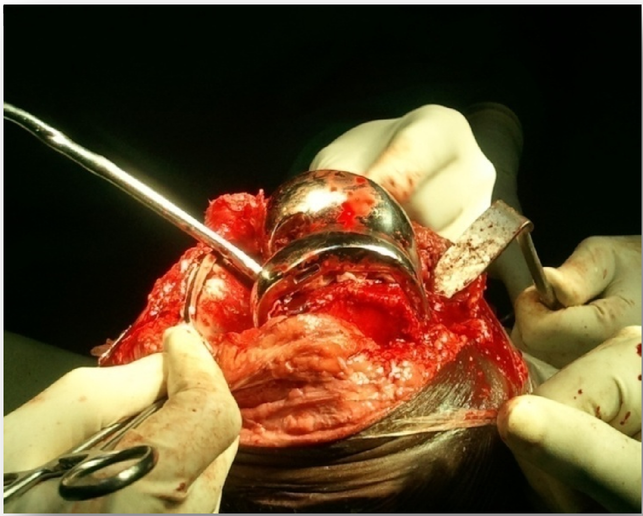
Cement applied over the tibial surface



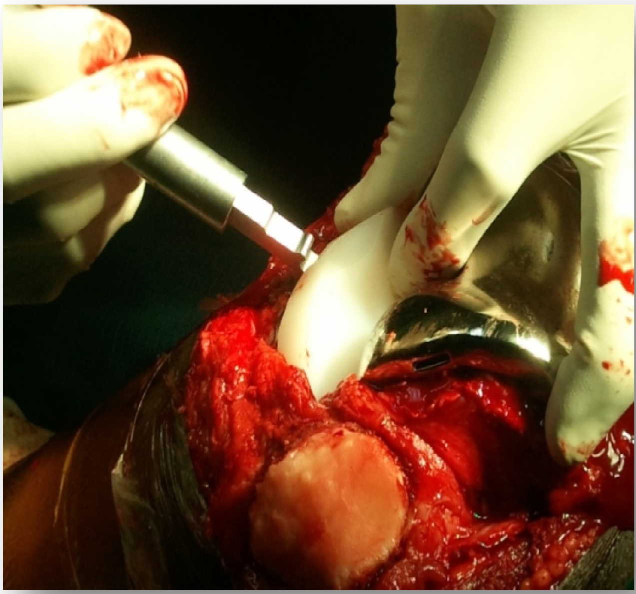
Tibial implant applied



Application of femoral component



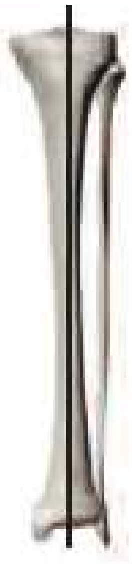
Femoral and Tibial implant in situ



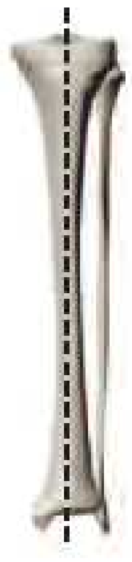
Articular insert applied

Mechanical axis of femur

Anatomical axis of femur

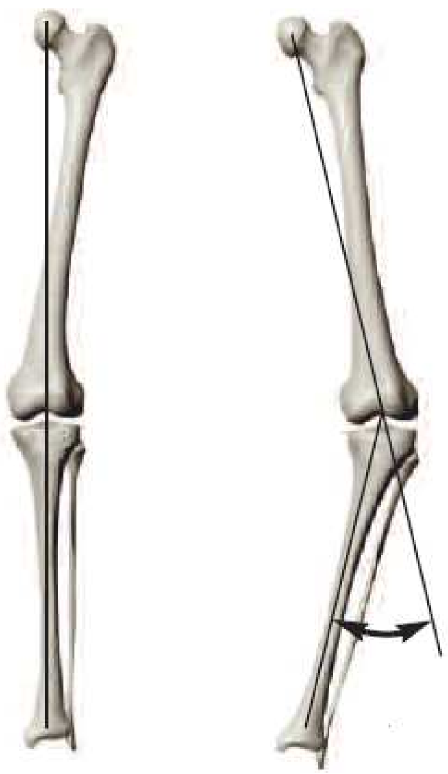


Anatomical axis of tibia



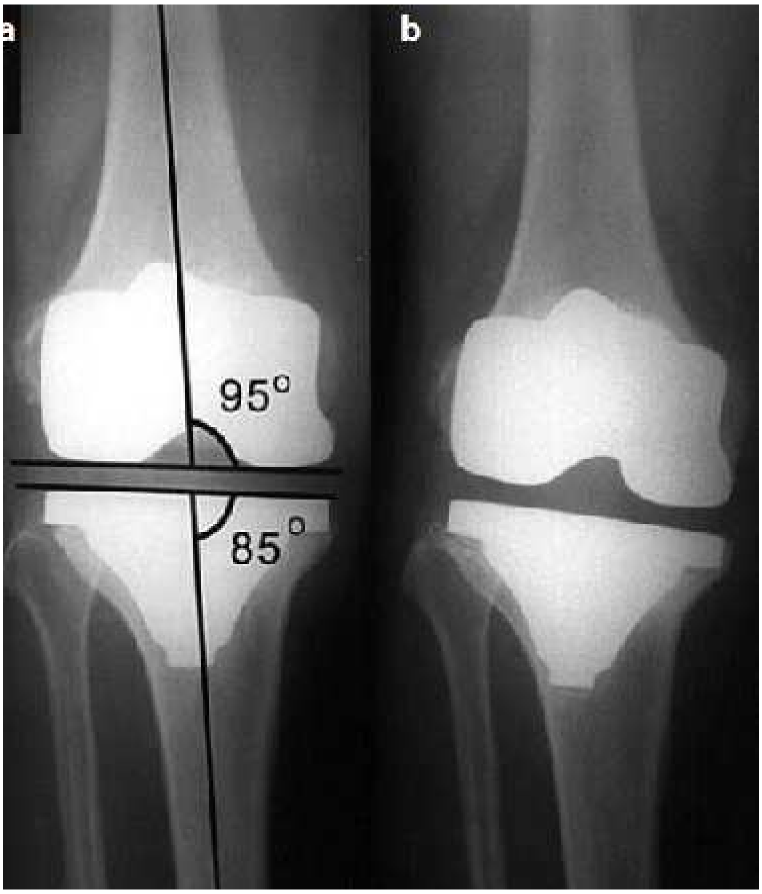
Mechanical axis of tibia

<u>Anatomical tibiofemoral axis</u>

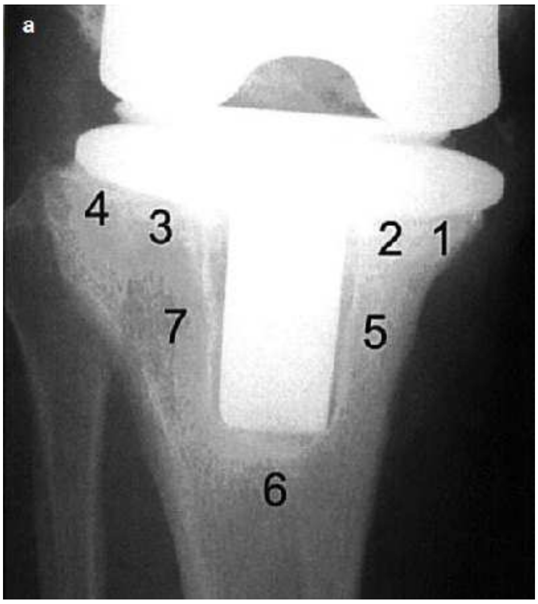


Mechanical Tibiofemoral axis

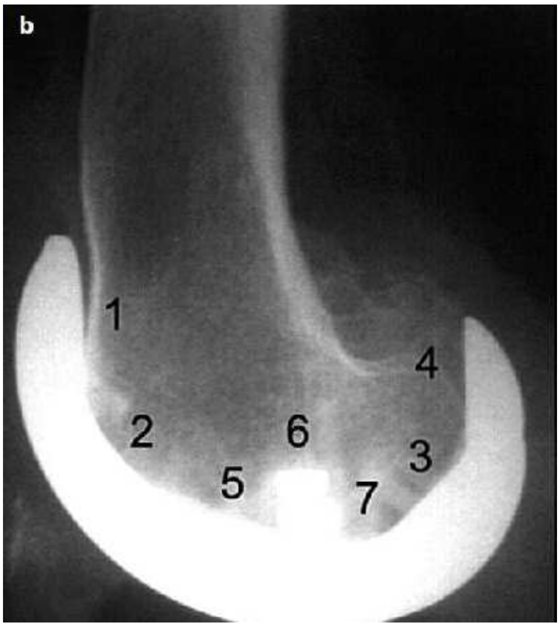
Step by step measurement of varus or valgus deformity



Tibio Femoral angle showing a suboptimal tibial angle of 85.The tibiofemoral angle is 180^0 which indicates the mechanical axis is at a varus of 5^0 .The radiograph in the right shows follow up x ray after five years, showing the tibial component going for varus collapse.



Cement zones for tibial component



Cement zones for femoral component